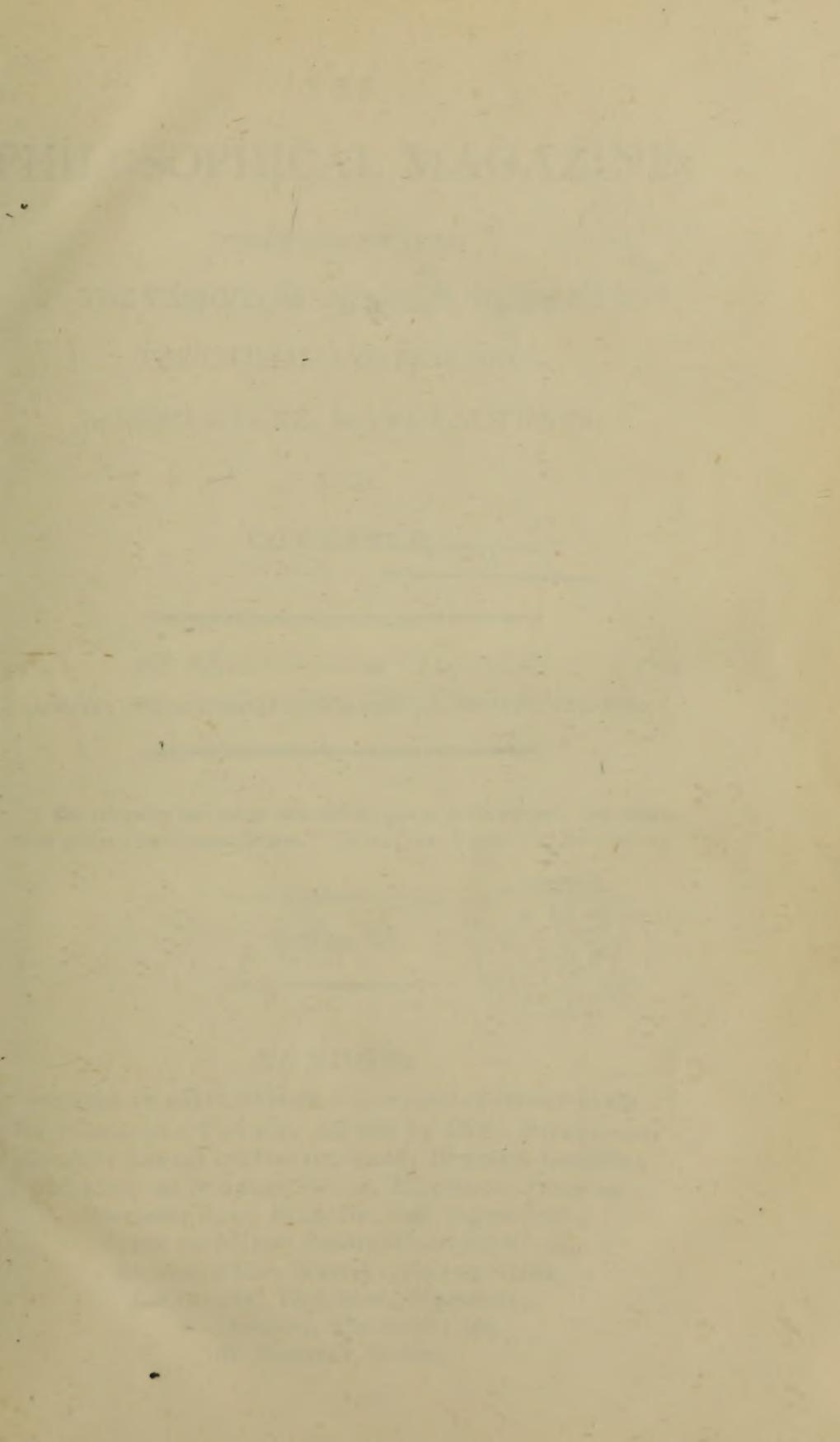


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THE

# PHILOSOPHICAL MAGAZINE:

COMPREHENDING

THE VARIOUS BRANCHES OF SCIENCE,

THE LIBERAL AND FINE ARTS,

AGRICULTURE, MANUFACTURES,

AND

COMMERCE.

---

BY ALEXANDER TILLOCH,

MEMBER OF THE LONDON PHILOSOPHICAL SOCIETY, ETC. ETC.

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"Nec aranearum sane textus ideo melior, quia ex se fila gignunt. Nec noster  
vilior quia ex alienis libamus ut apes." JUST. Lips. Monit. Polit. lib. i. cap. 1.

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VOL. VI.

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THE  
PHILOSOPHICAL MAGAZINE.

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FEBRUARY 1800.

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- I. *A new and expeditious Process for rendering Platina malleable. By Mr. RICHARD KNIGHT, Member of the British Mineralogical Society. Communicated by the Author.*

THE many peculiar advantages which platina in a malleable state possesses over every other metal for the fabrication of a variety of instruments and utensils particularly useful for the purposes of chemistry, together with the extreme difficulty of procuring it, being hitherto only to be obtained from Paris, of a very indifferent quality, and at a price equal to that of gold, first induced me to turn my attention to the subject. After having repeated a variety of experiments, from the different writers on this substance, without effect, I at length completed a process, the success of which has fully answered my expectations. By the process which I follow I am able to reduce any quantity of crude platina to a perfectly malleable state, entirely free from impurity, and capable of being wrought into any form whatever. As this is a circumstance of considerable importance to the chemical world, and the advantages which may result from it to society in general are perhaps incalculable, I would consider myself deserving of censure, could I allow any motive whatever to induce me to withhold it from the public. By sending it for publication in a work of such extensive circulation as the

Philosophical Magazine, it will meet the eyes of those for whom it is intended. If any benefit result from it to science, or the arts, my end is gained, and I shall feel amply repaid for my trouble. The method I pursue is as follows:—

To a given quantity of crude platina, I add 15 times its weight of nitro-muriatic acid (composed of equal parts of nitric and muriatic acids) in a tubulated glass retort, with a tubulated receiver adapted to it. It is then boiled, by means of an Argand's lamp, till the acid has assumed a deep saffron colour: it is then poured off; and if any platina remains undissolved, more acid is added, and it is again boiled until the whole is taken up. The liquor, being suffered to rest till quite clear, is again decanted: a solution of sal-ammoniac is then added, by little and little, till it no longer gives a cloudiness. By this means the platina is thrown down in the form of a lemon-coloured precipitate, which having subsided, the liquor is poured off, and the precipitate repeatedly washed with distilled water till it ceases to give an acid taste; (too much water is injurious, the precipitate being in a certain degree soluble in that liquid:) the water is then poured off, and the precipitate evaporated to dryness.

So far my process is in a great measure similar to that which some others have also followed; but my method of managing the subsequent, and which are indeed the principal manipulations, will be found to possess many advantages over any that has yet been made public. The best process hitherto followed has been, to give the precipitate a white heat in a crucible, which in some measure agglutinates the particles; and then to throw the mass into a red-hot mortar, or any similar implement, and endeavour to unite them by using a pestle or stamper. But the mass is so spongy that it is hardly possible to get a single stroke applied to it before the welding heat is gone; and though by peculiar dexterity and address some have in this way succeeded, it has been found to require such innumerable heatings and hammerings, that most of those who have attempted it, have either failed entirely, or given it up as being too laborious and expensive. I have succeeded in obviating all these difficulties, by adopting the following simple, easy, and expeditious method:—

A strong,

A strong, hollow, inverted cone of crucible earth being procured, with a corresponding stopper to fit it, made of the same materials, the point of the latter is cut off about three-fourths from the base. The platina, now in the state of a light yellow powder, is pressed tight into the cone, and, a cover being fixed slightly on, it is placed in an air-furnace \*, and the fire raised gradually to a strong white heat. In the mean time the conical stopper, fixed in a pair of iron tongs suitable for the purpose, is brought to a red, or to a bright red heat. The cover being then removed from the cone, the tongs with the heated stopper is introduced through a hole in the cover of the furnace, and pressed at first gently on the platina, at this time in a state nearly as soft as dough, till it at length acquires a more solid consistence. It is then repeatedly struck with the stopper, as hard as the nature of the materials will admit, till it appears to receive no farther impression. The cone is then removed from the furnace, and being struck lightly with a hammer, the platina falls out in a metallic button, from which state it may be drawn, by repeatedly heating and gently hammering, into a bar fit for flattening, drawing into wire, planishing, &c.

Besides the comparative facility of this process, it has the farther advantage of rendering the platina much purer than when red-hot iron is obliged to be had recourse to; for platina, when of a white heat, has a strong affinity for iron, and, with whatever care it may have been previously separated from that metal, will be found to have taken up a portion of it, when it is employed, of a red heat, to serve to unite the particles of the platina. To the superior purity of platina, rendered malleable by the process before described, I attribute the greater specific gravity which I find it to possess, than that prepared by other methods. Having taken the specific gravity of about ten penny weights of it, which I had previously passed repeatedly through a flattening mill, I found it to be 22.26.

Foster Lane, January 3, 1800.

\* The one I employ is portable, and tho' chamber for the fire only eight inches in diameter. K.

II. *Reflections on Prussiats.* By I. M. HAUSSMANN \*.

**T**O fix on stuffs with success the metallic prussiats, it was necessary to examine with care the results arising from the mixture of metallic solutions with the prussiats of pot-ash or of lime. The most interesting information which I procured by my experiments is as follows:—

The red oxyd of mercury subjected to the action of the liquor of prussiat of pot-ash or of lime, acidulated by the sulphuric acid, did not produce blue, but was transformed gradually into yellowish sulphat of mercury: next morning, after an addition of the muriatic acid, the change took place in an instant, and I obtained a blue exceedingly brilliant. Having, instead of the sulphuric acid, employed the muriatic, the red oxyd was dissolved, and the liquor became transparent, of a bad blue colour, which became gradually brighter as it was precipitated. The red oxyd of mercury, dissolved first by the nitric acid in excess, to which was added prussiat of pot-ash or of lime, furnished also a blue. The operation is slow when the red oxyd is used without dissolving it, and when you confine yourself to acidulating the prussiat with the nitric acid. An aqueous solution of the oxygenated muriat of mercury, mixed with a solution of prussiat of pot-ash or of lime, acidulated by the muriatic or nitric acid, gives also a very beautiful blue.

In all these processes of mercury, and particularly the last, a part of this oxygenated substance remains in solution, and resembles the liquor obtained by destroying the colour of the prussiat of iron by means of the red oxyd of mercury and of water. The oxyd of silver is changed with more difficulty. I diluted with water a nitric solution of that metal; and when I hit the just proportions of the prussiat of pot-ash, and the sulphuric or muriatic acid, I obtained, by shaking from time to time, the most beautiful blue in the space of twenty-four hours. The liquid arsenic acid, mixed with prussiat of pot-ash or of lime, acidulated with sulphuric acid, gives a very beautiful blue.

\* From *Journal de Physique*, an. 7.

A solution.

- A solution of cobalt furnishes a greyish violet, and, with the addition of muriat of ammonia, a beautiful violet blue; while, in treating solutions of the sulphat of zinc, the nitrat of bismuth, the muriat of tin, and the acetite of lead, with liquor of the prussiat of pot-ash or of lime, acidulated as before, you obtain only whites. Copper is precipitated under a brown shade. The muriat of antimony, precipitated by aqueous dilution, and exposed, like the oxyd of silver, to the action of the acidulated prussiat of pot-ash, indicates some disposition to become blue. Adding to the muriatic solution of the black oxyd of manganese, muriat of ammonia, and mixing this solution with liquor of the prussiat of pot-ash, acidulated by the sulphuric acid, there is formed a very beautiful blue.

I must inform chemists' not to be discouraged when the production of blue does not immediately take place; if it should happen that they do not obtain it, they must vary the proportions until they have accomplished their end. The blue of silver often does not succeed till after a long time, and does not acquire its utmost degree of intensity till the end of eight, ten, or fifteen days.

As I intended to repeat and continue these experiments by the mixture of metallic solutions with liquor of the prussiats of pot-ash and lime acidulated, I first exposed to the action of these liquors, some metallic oxyds fixed upon stuffs. Cotton cloth, which had imbibed a solution of native platina almost insensible to the magnet, after being wrung was dipped, without drying it, in a solution of caustic pot-ash; the oxyd of platina remained, in a great part, adhering to the stuff, which being washed, assumed a yellow much more beautiful than that obtained from iron. Having dipped this cloth in a solution of prussiat of pot-ash or of lime, acidulated by the sulphuric acid, I obtained as lively a blue, and in as short a time as if I had employed cloth coloured by the oxyd of iron. A mixture of the solution of platina and of tin dissolved in the muriatic acid, with an excess of acid, is of a beautiful transparent red colour. Without excess of acid, there is formed, at first, a precipitate of a beautiful orange

orange colour. This process might furnish another means of purifying platina.

A piece of cotton cloth impregnated with a solution of gold, containing a sixth part of that metal without excess of acid, being plunged in a solution of ammonia, furnished me with an ochre yellow. This yellow at length became blackish after being kept in a sheet of paper. As alkaline liquors, and particularly that of the carbonat of pot-ash or of soda, have a great tendency to dissolve the oxyd of gold, it cannot be used for its precipitation on cloth. Cloth coloured yellow by gold dipped in muriat of tin diluted with water, undergoes a change into dark blackish grey, which becomes brighter in proportion as the solution is diluted. I have often obtained violets and lilacs by dipping, without precipitation, the cloth merely imbibed with a solution of gold, in nitro-muriatic solutions of tin prepared with different proportions of the acid. Several shades of gold colour will be obtained by precipitating oxyd of tin from its nitro-muriatic solution by dilution with water, to which a solution of gold has been added, drop by drop, at different times, with intervals of several hours. This mode of operation will furnish orange colours, while, if you substitute oxyd of gold for the solution, you will obtain lilacs, which, approaching more and more to shades of crimson, will at last become orange, if you continue to add to them, from time to time, oxyd of gold. These shades depend a great deal on the proportion of muriatic acid present in the nitro-muriatic solution of tin. If it contains too great a quantity, the dose of water must be augmented to make the oxyd of tin precipitate itself, and the gold in that case gives a grey colour more or less reddish. The solution of tin, which I employed for these experiments, was composed of four parts of nitric acid, one of muriatic acid, and one and a quarter of granulated tin, slowly dissolved, to prevent, as much as possible, the nitrous gas from being disengaged in too great quantity. These oxyds of tin, coloured by the oxyd of gold more or less de-oxygenated, do not require much metal, and consequently are not dear. They all present, when dry, different shades of grey and lilac more or less intense, and in all probability might be employed for painting porcelain.

Stuff coloured by the oxyd of gold seems to attract the colouring particles of madder, and assumes a reddish-brown tint, or a sort of carmelite, which is more and more blackened by a continuation or increase of the heat. The other ingredients proper for dyeing also blacken gold by the help of heat. Galls, by ebullition, have an analogous effect, and produce almost the same greyish-black colour as that obtained by dipping in a muriatic solution of tin, probably because all these means de-oxygenate the oxyd of gold. The change into blue, of stuff coloured yellow by the oxyd of gold exposed to the action of dissolved prussiat of pot-ash or of lime, acidulated by the sulphuric or any other acid, takes place only slowly. Three, four, and even five hours immersion are necessary to obtain a beautiful blue of equal intensity with the yellow produced by gold. By acidulating too strongly the liquor of the prussiat, the oxyd of gold dissolves without giving a blue.

It is not uncommon to see the experiment fail when the solution of gold is directly mixed with a solution of an alkaline prussiat or a prussiat of lime. Every thing here depends on the degree of acidulation; but the experiment will generally succeed when the oxyd of gold has been previously precipitated by ammonia or some other alkali.

I for a long time imagined that these blues arose from the metal employed, and formed prussiats. I was so full of this idea, that, when I made the discovery in 1781, I communicated it to the celebrated professor Spielmann, who returned me the following answer:—"Westenberg, in a dissertation maintained at Gottingen in 1772, and Martin more amply in a thesis printed here in 1775, remarked, that ley of blood precipitated gold under a blue colour; but that, to obtain this colour, it was necessary to make use of an acid. The latter observed chiefly, that alkali, saturated with prussian blue, precipitated gold immediately of a blue colour; and that, if ley of blood was deprived of all volatile alkali by distillation, the residuum, more concentrated, dyed still more easily the metals it precipitated from their menstrua." At the time when I was employed in repeating my experiments, my friend Charles Bartholdi objected to me, that all my blues

blues arose only from iron, which the solutions of prussiats of pot-ash and of lime hold more or less in solution. I learned also, from a passage in Buffon in his observations on the nature of platina, that Morveau had doubted the experiment of Fourci, who precipitated gold of a blue colour by the prussian alkali. Though we cannot deny the existence of iron in prussiats of alkalies and of lime, I could, however, with difficulty believe that a metallic substance fixed on stuff, could be replaced by any other which would at the same time remain fixed.

If, in my experiment on cloth coloured by the oxyd of gold, that oxyd had disappeared; if the prussiat of iron had been precipitated in the liquor, instead of being fixed on the stuff; if the ashes of some specimens had not gilded silver; and, in the last place, if the intensity of blues had not been so considerable and so general, and the shades of each different, I should certainly have been sooner freed from my error; but I now am, and the following is the method in which I proceeded to convince myself of my mistake:—I deprived of its colour, by means of a solution of pot-ash, a piece of cotton cloth coloured yellow by gold, and then rendered blue: I washed it, and immersed it for several hours in a muriatic solution of tin, and produced the same effect as with the oxyd of iron. This cloth, deprived of its colour, and become of a yellow similar to that produced by the oxyd of iron, was changed into blue by alkaline prussiats as speedily as the latter. This blue cloth, as well as that deprived of its colour by pot-ash when reduced to ashes, scarcely gilded silver; and these ashes, treated with mercury, furnished only a slight gilding, arising no doubt from a small portion of the oxyd of gold which had remained untouched in the liquor of the acidulated prussiats, which, by longer immersion of the stuff, could not have failed to have been taken up.

These proofs were too striking not to induce me to continue my experiments. I soaked, therefore, the cotton cloth in a nitric solution of silver, and, without drying it, I dipped it in a solution of caustic pot-ash; the oxyd fixed on the stuff presented inequalities, and exhibited different shades of violet, lilac, grey, and yellow. The action of the atmosphere

had a great influence on the tone of these shades. The stuff, after being dried, was left for fifteen days in a solution of prussiat of pot-ash acidulated by the nitric, muriatic, or sulphuric acids, and assumed a pretty equal blue colour, of great beauty and splendour; but, when deprived of its colour by caustic pot-ash, it could not be brought back to its first shades. The yellow preserving a decided superiority seemed to obscure the rest; which shews that the prussiat of iron had displaced a great part of the oxyd of silver.

The nitric solution of the red oxyd of mercury, with which I impregnated the cotton in order to dip it in a solution of caustic pot-ash, gave a very beautiful yellow, while the nitric solution of mercury, newly made, produced a grey; but these two shades, having been left some days in the solution of the prussiat of pot-ash acidulated by the nitric, muriatic, or sulphuric acids, were changed into blue. The colour being afterwards discharged by caustic alkali, the grey and yellow shades reappeared—with this difference, that the latter had a greater resemblance to the rust of iron. What is singular is, that the grey differed very little from its first shade: if, however, the grey oxyd of mercury had been obscured by the prussiat of iron, discharging the colour must have produced an ochre yellow.

All these experiments present phenomena so singular that they deserve to be repeated; which I shall perhaps do; but in the mean time it appears to me true that the greater part of these blues are only prussiat of iron: the changes by affinity, however, are extraordinary. It is, above all, on the grey oxyd of mercury charged blue, that it is of importance to fix attention.

As the precipitates which are formed in mixtures of metallic solutions with solutions of prussiats, of alkalies, or of lime, acidulated, though not blue, are still prussiats under different colours, it is very probable that the metallic oxyds, such as that of gold fixed on stuff destined to be changed into blue, become prussiats, soluble in acids. In regard to the blue of platina, I have no doubt that it is a prussiat of that metal; its change is effected as speedily as that of iron.

III. *Account of a simple and effectual Preparation of Seeds  
of Corn.* By Mr. JOHN WAGSTAFFE, of Norwich\*.

**T**HREE has been long sought for, and, in the opinion of some, long since obtained, a perfect cure of the disease in wheat and other grain, provincially known by various names, as smut, foot-brand, &c. which are but one and the same disease.

From the partial judgment of many individuals, it has been asserted, that such and such caustics, salts, and washes, have been completely destructive of this bane; yet, however such individuals may have escaped its malignity, the repeated use of their recipes has not succeeded with others to whom their process has been communicated: but I am convinced, by a series of repeated experiments, that every person, who duly practises the simple means I now lay before you, will be exempted from its immediate bane; and a district of country, by pursuing the same means, may perhaps escape future contagion.

The means are simple; and are no other than immersing the seed in pure water, and repeatedly scouring it therein, just before it is sown or dibbled in the soil. Whether well-spring, or river water be used, is indifferent; but repeated stirring and change of water is essential to remove the particles of infection that may have imperceptibly adhered to the seeds thus purified: the subsequent crop will be perfect in itself, and its seeds (I am persuaded) successively so likewise, if there are no adjacent fields from whence this contamination may be wafted. Before I give you a series of experiments, which have confirmed to me the complete cure of the disease in question, permit me to observe, that many years since, believing that this corrupt substance of smut occasioned its perpetuation, I took some grains of wheat from a stock that had been known not to be affected with smut; these grains I blackened with its dust, and the succeeding summer confirmed my opinion, as near half the produce was

\* From Letters and Papers of the Bath and West-of-England Society for the Encouragement of Agriculture, &c.

smut-balls. Here I stopped; and in my own small practice used some of the strongly recommended nostrums that were said always to effect a cure, and which apparently they did, as I uniformly steeped the grain in rain water before I made the addition of a disgusting fluid, or commixture of I know not what strange substances.

About two years since, I was called upon by an intelligent farmer (Roger Tresley) of Devonshire, who *confidentially* (because he had a subscription in view) laid this simple process before me. I was immediately convinced, by comparing what I had practised with the principle he advanced.

I then repeated my former experiments. I took a handful of pure wheat, and blackened it, by rubbing in as much smut-brand as I was able; after which, I divided this corrupted handful into two equal parts; retained one part with all its corrupt impregnation\*, and the other part I well cleansed in water from its baneful particles: these two parts I again subdivided into three portions each, two of which I dibbled in different situations, *viz.* a portion of the pure and impure, near to, but distinctly separated from, each other; two other portions some miles from the former two: and the remaining two (the corrupted and the cleansed) I committed to the care of an accurate neighbour for his putting into the ground, at which I was present, and witnessed the exactness of the separation. The products of these several trials were uniformly the same: the unwashed was generally smutty; the washed good in quality, one single set excepted. Thus fully convinced, and confirmed in the efficacy of the means recommended, I engaged the farmers of a certain parish (Baburgh) to advance me a guinea for Roger Tresley's publication, assuring the principal occupier†, that he would be convinced

\* Wholesome water has a tendency to promote vegetation, while some of the fetid and corrosive fluids have a tendency to destroy its principle; in course, some, perhaps much, of the seed perishes in the soil.

† This farmer had been subject many years to brand, notwithstanding his constant use of saline and other substances; at length he changed these for a recipe from a gentleman to whose opinion he paid much deference; but it proved, that on this change he had more brand than before; his thence resolved to use no more preparations, but brought all his seed

convinced of its certainty, without waiting the issue of a harvest. The consequence of which has been, that I have neither seen nor heard of a smutty ear in this district; which, I believe, hath in no preceding year been free from them. In fine, not only from the experiments already adverted to, but from others which might be adduced, I am fully persuaded that the confirmation of this discovery (and it has been many years back suggested) will lead to an incalculable advantage; for it is not alone a preservation of the most indispensable article of human food from an appearance and flavour truly disgusting; but, while it renders it more nutritious, it also augments its quantity; for every smut-ball might have been a perfect grain, by using the simple process referred to. To this let me add, that other kinds of bread, as well as that more generally used, may be augmented and improved; since barley and oats equally escape this contamination and diminution, if their seeds are equally purified.

*IV. On the Distillation of ardent Spirit from Carrots. By Dr. HUNTER and Mr. HORNBY, of York\*.*

**O**NE ton and eight stone of carrots, which, after being exposed to the air a few days to dry, weighed one hundred and sixty stone, and measured forty-two bushels, were washed, topped, and tailed, by which they lost in weight eleven stone, and in measure seven bushels: being then cut, they were boiled, with the proportion of twenty-four gallons of water to one-third of the above quantity of carrots, until the whole was reduced to a tender pulp, which was done in three hours

wheat to the pump, and has not had (he says) any brand since. And what is still more confirming, a gentleman farmer in this vicinity applied to me for Roger Treffey's process, in consequence of his whole crop of wheat being so excessively infected with smut, that his threshers daily, at the close of their labour, cleansed themselves in water, they being, as he expressed it, as black as chimney-sweepers: yet his subsequent crop of wheat from this seed, scoured in repeated washings, escaped the taint, except a piece of land in contiguity with the homestead; which this gentleman ascribed to the pollution which fled over it from divers dressings.

\* From the *Transactions of the Royal Society of Edinburgh,*

boiling;

boiling. From this pulp the juice was easily extracted, by means of a press, and two hundred gallons of juice were produced from the whole. This juice was boiled again, with one pound of hops, five hours, and then cooled to  $56^{\circ}$  of Fahrenheit; and, six quarts of yeast being added, it was set to ferment. The strong fermentation lasted forty-eight hours, during which time the heat abated to  $53^{\circ}$  of Fahrenheit. Twelve gallons of unfermented juice, which had been reserved, were then heated, and added to the liquor, the heat of which was thus raised again to  $66^{\circ}$ , and the fermentation was renewed for twenty-four hours more, the air of the brew-house being all this time at  $46^{\circ}$  and  $44^{\circ}$ . The liquor was now tunned, and continued to work three days from the bung. Lastly, it was distilled; and the first distillation was rectified the next day, without any addition. The produce was twelve gallons of spirit\*.

The refuse of the carrots weighed forty-eight stone, which, added to the tops and tails, made provision for hogs, besides the wash from the still, which measured one hundred and fourteen gallons.

From this experiment, which was made by Mr. Hornby, Dr. Hunter draws the following comparison between the distillation of carrots and that of grain:

Twenty tons of carrots, which will make two hundred gallons of proof-spirit, may be bought for 16*l.*

Eight quarters of malt, or rather of materials for distillation, consisting of malt, wheat, and rye, may be bought for 16*l.* and will also yield two hundred gallons of proof-spirit.

The refuse from the carrots will be nine hundred and sixty stone, which, at one penny *per* stone, will sell for 4*l.*

The refuse, or grains, from the malt, &c. will be sixty-four bushels, each bushel about three stone, which, at one penny *per* stone, will sell for 16*s.*

Dr. Hunter, however, supposes that the manufacturing of the spirit from carrots may be attended with more expence

\* A sample of this spirit, which was sent along with the paper, was examined by Dr. Black, Dr. Hutton, and Mr. Russell: they found that it resembled a corn spirit in flavour, but that it was equal to a corn spirit of the best kind, and that it was proof.

than the manufacturing it from malt; but imagines that the greater value of the refuse may compensate for that expence; and that the saving of corn, for other purposes, is an object worthy of attention and encouragement.

**V. Some Account of the Elastic-Gum Vine of Prince of Wales's Island, and of Experiments made on the milky Juice which it produces; with Hints respecting the useful Purposes to which it may be applied. By JAMES HOWISON, Esq.\***

OUR first knowledge of the plant being a native of our island arose from the following accident:—In our excursions into the forests it was found necessary to carry cutlasses for the purpose of clearing our way through the underwood. In one of those an elastic-gum vine had been divided, the milk of which drying upon the blade, we were much surprised in finding it possess all the properties of the American *Cauchoic*. The vine which produces this milk is generally about the thickness of the arm, and almost round, with a strong ash-coloured bark, much cracked, and divided longitudinally; has joints at a small distance from each other, which often send out roots, but seldom branches; runs upon the ground to a great length; at last rises upon the highest trees into the open air. It is found in the greatest plenty at the foot of the mountains, upon a red clay mixed with sand, in situations completely shaded, and where the mercury in the thermometer will seldom exceed summer heat.

In my numerous attempts to trace this vine to its top, I never succeeded; for, after following it in its different windings, sometimes to a distance of two hundred paces, I lost it, from its ascending among the branches of trees that were inaccessible either from their size or height. On the west coast of Sumatra, I understand, they have been more successful; Doctor Roxburgh having procured from thence a specimen of the vine in flowers, from which he has classed it, but whose description I have not yet seen.

\* From the *Asiatic Researches*, Vol. V.

With us the Malays have found tasting of the milk the best mode of discriminating between the elastic-gum vine and those which resemble it in giving out a milky juice, of which we have a great variety; the liquid from the former being much less pungent or corrosive than that obtained from the latter.

The usual method of drawing off the milk is by wounding the bark deeply in different places, from which it runs but slowly, it being full employment for one person to collect a quart in the course of two days. A much more expeditious mode, but ruinous to the vine, is cutting it in lengths of two feet, and placing under both ends vessels to receive the milk. The best is always procured from the oldest vines. From them it is often obtained in a consistence equal to thick cream, and which will yield two-thirds of its own weight in gum.

The chemical properties of this vegetable milk, so far as I have had an opportunity of examining, surprisingly resemble those of animal milk. From its decomposition in consequence of spontaneous fermentation, or by the addition of acids, a separation takes place between its caseous and ferous parts, both of which are very similar to those produced by the same processes from animal milk. An oily or butyrous matter is also one of its component parts, which appears upon the surface of the gum so soon as the latter has attained its solid form. The presence of this considerably impeded the progress of my experiments, as will be seen hereafter.

I was at some trouble in endeavouring to form an extract of this milk so as to approach to the consistence of new butter, by which I hoped to retard its fermentative stage without depriving it of its useful qualities; but, as I had no apparatus for distilling, the surface of the milk, that was exposed to the air, instantly formed into a solid coat, by which the evaporation was in a great degree prevented. I however learned, by collecting the thickened milk from the inside of the coats, and depositing it in a jelly-pot, that, if excluded from the air, it might be preserved in this state for a considerable length of time.

I have kept it in bottles, without any preparation, tolerably

7 good,

good, upwards of one year; for, notwithstanding the fermentation soon takes place, the decomposition in consequence is only partial, and what remains fluid still retains its original properties, although considerably diminished.

Not having seen M. Fourcroy's memoir on *Caout-chouc*, I could not make trials of the methods proposed by him for preserving the milk unaltered.

In making boots, gloves, and bottles, of the elastic gum, I found the following method the best:—I first made moulds of wax, as nearly of the size and shape of what they represented as possible; these I hung separately upon pins, about a foot from the ground, by pieces of cord wrought into the wax: I then placed under each a soup-plate, into which I poured as much of the milk as I thought would be sufficient for one coat. Having dipped my fingers in this, I completely covered the moulds one after another, and what dropped into the plates was used as part of the next coat: the first I generally found sufficiently dry in the space of ten minutes, when exposed to the sun, to admit of a second being applied: however, after every second coat, the oily matter before mentioned was in such quantity upon the surface, that, until washed off with soap and water, I found it impossible to apply any more milk with effect; for, if laid on, it kept running and dividing like water upon wax.

Thirty coats I in common found sufficient to give a covering of the thickness of the bottles which come from America. This circumstance may, however, at any time be ascertained by introducing the finger between the mould and gum, the one very readily separating from the other.

I found the fingers preferable to a brush, or any instrument whatever, for laying on the milk; for, the moment a brush was wet with that fluid, the hair became united as one mass. A mode which at first view would appear to have the advantage of all others for ease and expedition in covering clay and wax moulds with the gum, viz. immersing them in the milk, did not at all answer upon trial; that fluid running almost entirely off, although none of the oily matter was present; a certain degree of force seeming necessary to incorporate, by friction, the milk with the new-formed gum.

When,

When, upon examination, I found that the boots and gloves were of the thickness wanted, I turned them over at the top, and drew them off, as if from the leg or hand, by which I saved the trouble of forming new moulds. Those of the bottles being smallest at the neck, I was under the necessity of dissolving in hot water.

The inside of the boots and gloves which had been in contact with the wax being by far the smoothest, I made the outside. The gloves were now finished, unless cutting their tops even, which was best done with scissars. The boots, however, in their present state, more resembled stockings, having as yet no soles. To supply them with these, I poured upon a piece of gunny a proper quantity of milk, to give it a thick coat of gum. From this, when dry, I cut pieces sufficiently large to cover the sole of the foot, which, having wet with the milk, I applied; first replacing the boot upon the mould to keep it properly extended. By this mode the soles were so firmly joined, that no force could afterwards separate them. In the same manner I added heels and straps, when the boots had a very neat appearance. To satisfy myself as to their impermeability to water, I stood in a pond up to their tops for the space of fifteen minutes, when, upon pulling them off, I did not find my stockings in the least damp. Indeed, from the nature of the gum, had it been for a period of as many months, the same result was to have been expected.

After being thus far successful, I was greatly disappointed in my expectations with regard to their retaining their original shape; for, on wearing them but a few times, they lost much of their first neatness, the contractions of the gum being only equal to about seven-eighths of its extension.

A second disadvantage arose from a circumstance difficult to guard against, which was, that if, by any accident, the gum should be in the smallest degree weaker in one place than another, the effect of extension fell almost entirely on that part, and the consequence was that it soon gave way.

From what I had observed of the advantage gained in substance and uniformity of strength by making use of gunny as a basis for the soles, I was led to suppose, that if an elastic

cloth, in some degree correspondent to the elasticity of the gum, were used for boots, stockings, gloves, and other articles where that property was necessary, that the defects above-mentioned might in a great measure be remedied. I accordingly made my first experiment with Cossimbazar stockings and gloves.

Having drawn them upon the wax moulds, I plunged them into vessels containing the milk, which the cloth greedily absorbed. When taken out, they were so completely distended with the gum in solution, that, upon becoming dry by exposure to the air, not only every thread, but every fibre of the cotton had its own distinct envelope, and, in consequence, was equally capable of resisting the action of foreign bodies as if of solid gum.

The first coat by this method was of such thickness, that, for stockings or gloves, nothing farther was necessary. What were intended for boots required a few more applications of milk with the fingers, and were finished as those made with the gum only.

This mode of giving cloth as a basis I found to be a very great improvement; for, besides the addition of strength received by the gum, the operation was much shortened.

Woven substances, that are to be covered with the gum, as also the moulds on which they are to be placed, ought to be considerably larger than the bodies they are afterwards intended to fit; for, being much contracted from the absorption of the milk, little alteration takes place in this diminution in size even when dry, as about one-third only of the fluid evaporates before the gum acquires its solid form.

Great attention must be paid to prevent one part of the gum coming in contact with another while wet with the milk, or its whey; for, the instant that takes place, they become inseparably united. But should we ever succeed in having large plantations of our own vine, or in transferring the American tree (which is, perhaps, more productive) to our possessions, so that milk could be procured in sufficient quantity for the covering various cloths, which should be done on the spot, and afterwards exported to Europe, then the advantages attending this singular property of the milk would

would for ever balance its disadvantages : cloths, and coverings of different descriptions, might then be made from this gum-cloth with an expedition so much greater than by the needle that would at first appear very surprising ; the edges of the separate pieces only requiring to be wet with the milk, or its whey, and brought into contact, when the article would be finished and fit for use. Should both milk and whey be wanting, a solution of the gum in ether can always be obtained, by which the same end would be accomplished.

Of all the cloths upon which I made experiments, nankeen, from the strength and quality of its fabric, appeared the best calculated for coating with the gum. The method I followed in performing this, was, to lay the cloth smooth upon a table, pour the milk upon it, and, with a ruler, to spread it equally. But, should this ever be attempted on a larger scale, I would recommend the following plan :—To have a cistern for holding the milk a little broader than the cloth, to be covered with a cross bar in the centre, which must reach under the surface of the milk, and two rollers at one end. Having filled the cistern, one end of the piece of cloth is to be passed under the bar, and through between the rollers ; the former keeping the cloth immersed in the milk, the latter in pressing out what is superfluous, so that none may be lost. The cloth can be hung up at full length to dry, and the operation repeated until of whatever thickness wanted. For the reasons above-mentioned, care must be taken that one fold does not come in contact with another while wet.

Having observed that most of the patent catheters and bougies made with a solution of the elastic gum, whether in ether or in the essential oils, had either a disagreeable stickiness, or were too hard to admit of any advantage being derived from the elasticity of the gum ; I was induced to make some experiments with the milk towards removing these objections.

From that fluid, by evaporation, I made several large-sized bougies of pure gum, which, from their over-flexibility, were totally useless. I then took some slips of fine cloth covered with the gum, which I rolled up until of a proper size,

and which I rendered solid, by soaking them in the milk and then drying them. These possessed more firmness than the former, but in no degree sufficient for the purpose intended. Pieces of strong catgut, coated with the gum, I found to answer better than either.

Besides an effectual cloathing for manufacturers employed with the mineral acids, which had been long a desideratum, this substance, under different modifications, might be applied to a number of other useful purposes in life; such as making hats, great coats, boots, &c. for sailors, soldiers, fishermen, and every other description of persons who, from their pursuits, are exposed to wet stockings; for invalids, who suffer from damps; bathing caps, tents, coverings for carriages of all kinds, for roofs of houses, trunks, buoys, &c.

This extraordinary vegetable production, in place of being injured by water at its usual temperature \*, is preserved by it. For a knowledge of this circumstance I am indebted to the Chinese. Having, some years ago, commissioned articles made of the elastic-gum, from China, I received them in a small jar filled up with water; in which state I have since kept them without observing any signs of decay.

Should it ever be deemed an object to attempt plantations of the elastic-gum vine in Bengal, I would recommend the foot of the Chittagong, Rajmahal, and Bauglipore hills, as situations where there is every probability of succeeding, being very similar in soil and climate to the places of its growth on Prince of Wales's Island. It would, however, be advisable to make the first trial at this settlement, to learn in what way the propagation of the plant might be most successfully conducted. A further experience may also be necessary to ascertain the season when the milk can be procured of the best quality, and in the greatest quantity, with the least detriment to the vine.

\* From an account of experiments made with the elastic gum by M. Grossart, inserted in the *Annales de Chimie* for 1792, it appears, that water, when boiling, has a power of partially dissolving the gum so as to render one part capable of being finally joined to another by pressure only,

VL. *Experiments and Observations on Shell and Bone.* By  
CHARLES HATCHETT, Esq. F. R. S. \*

SOME experiments which I lately made at the request of Mr. Home, and which he has done me the honour to mention in his ingenious paper on the teeth of granivorous quadrupeds, induced me to turn my attention more particularly to the chemical examination of shell and bone, especially as the former appeared to have been hitherto much neglected.

The time since these experiments were begun, has not been sufficient to enable me to enter into all the minutiae of the chemical analysis of these substances; but, as some remarkable facts were ascertained, I have now ventured to bring them forward, with the addition of some observations, although as yet the whole is little more than a very imperfect outline.

The first of these experiments were made on the shells of marine animals; and to avoid repetition and prolixity, I shall, in a great measure, once for all, describe the menstrua, the precipitants, and the mode of operation.

When shells were examined, they were immersed in acetous acid, or nitric acid, diluted, according to circumstances, with four, five, six, or more parts of distilled water; and the solution was always made without heat.

The carbonate of lime was precipitated by the carbonate of ammoniac, or of pot-ash; and phosphate of lime (if present) was previously precipitated by pure or caustic ammoniac.

If any other phosphate like that of soda was suspected, it was discovered by solution of acetite of lead.

Bones and teeth were also subjected to the action of the acetous, or diluted nitric and muriatic acids.

The dissolved portion was examined by the above-mentioned precipitants; and, in experiments where the quantity of the substance would permit, the phosphoric acid was also separated by nitric or sulphuric acid. The phosphoric acid thus obtained, was proved after concentration by experi-

\* From the *Philosophical Transactions* for 1799.

ments,

ments, which being usually employed for such purposes, are too well known to require description.

It is necessary moreover to observe, that as the substances examined were very numerous, and my principal object was to discover the most prominent characters in them, I did not for the present attempt in general to ascertain minutely the proportions so much as the number and quality of their respective ingredients.

The greater part, if not all, of marine shells, appear to be of two descriptions in respect to the substance of which they are composed. Those which will be first noticed have a porcellaneous aspect with an enamelled surface, and when broken are often, in a slight degree, of a fibrous texture.

The shells of the other division have generally, if not always, a strong epidermis, under which is the shell, principally or entirely composed of the substance called *nacre*, or *mother-of-pearl*.

Of the porcellaneous shells, various species of *voluta*, *cyprea*, and others of a similar nature were examined.

Of the shells composed of *nacre*, or *mother-of-pearl*, I selected the oyster, the river muscle, the *baliotis iris*, and the *turbo olearius*.

#### *Experiments on Porcellaneous Shells.*

Shells of this description, when exposed to a red heat in a crucible during about a quarter of an hour, crackled and lost the colours of their enamelled surface; they did not emit any apparent smoke, nor any smell like that of burnt horn or cartilage. Their figure remained unchanged, excepting a few flaws; and they became of an opaque white, tinged partially with pale grey, but retained part of their original gloss.

The shells which had not been exposed to fire (whether entire or in powder) dissolved with great effervescence in the various acids; and the solution afterwards remained colourless and transparent. But the shells which had been burned, upon being dissolved, deposited a very small quantity of animal coal; and thereby the presence of some gluten was denoted, although the proportion was too small to be discovered in the solution of the shells which had not been burned.

The various solutions were filtrated, and were examined by pure ammoniac and acetite of lead; but I never obtained any trace of phosphate of lime, nor of any other combination of phosphoric acid.

The carbonate of lime was afterwards precipitated by carbonate of ammoniac; and from many experiments it appeared, that porcellaneous shells consist of carbonate of lime, cemented by a very small portion of animal gluten.

Previous to the experiments on shells composed of nacre, or mother-of-pearl, I examined some patellæ from Madeira.

When these were exposed to a red heat in a crucible, there was a perceptible smell, like that of horn, hair, or feathers.

The proportion of carbonic matter deposited by the subsequent solution was more considerable than that of the shells above mentioned, and the proportion of carbonate of lime relative to their weight was less.

When the recent shells were immersed in very dilute nitric acid, the epidermis was separated, the whole of the carbonate of lime was dissolved, and a gelatinous substance, nearly liquid, remained, but without retaining the figure of the shell, and without any fibrous appearance.

These shells evidently, therefore, contain a larger portion of a more viscid gelatinous substance than those before mentioned; but the solution separated from the gelatinous substance afforded nothing but carbonate of lime.

#### *Experiments on Shells composed of Nacre, or Mother-of-Pearl.*

When the shell of the common oyster was exposed to a red heat, the effects were the same as those observed in the patellæ; and the solution of the unburned shell was similar, only the gelatinous part was of a greater consistency.

A species of the river muscle was next subjected to experiment. This, when burned in a crucible, emitted much smoke, with a strong smell of burned cartilage, or horn; the shell throughout became of a dark grey, and exfoliated. By solution in the acids a large quantity of carbonic matter was separated; and much less of carbonate of lime was obtained from a given weight of the shell than from those already mentioned.

Upon

Upon immersing an unburned shell in dilute nitric acid, a rapid solution and effervescence at first took place, but gradually became less, so that the disengagement of the carbonic acid gas was to be perceived only at intervals.

At the end of two days I found nearly the whole of the carbonate of lime dissolved, but a series of membranes retaining the figure of the shell remained, of which the epidermis constituted the first.

In the beginning the carbonate of lime was readily dissolved, because the acid menstruum had an easy access; but after this it had more difficulty to infinuate itself between the different membranes, and of course the solution of the carbonate of lime was slower.

During the solution the carbonic acid gas was entangled, and retained in many places between the membranes, so as to give to the whole a cellular appearance.

The *baliotis iris* and the *turbo olearius* resembled this muscle, excepting that their membranaceous parts were more compact and dense.

These shells, when deprived, by an acid menstruum, of their hardening substance, or carbonate of lime, appear to be formed of various membranes applied stratum super stratum.

Each membrane has a corresponding coat or crust of carbonate of lime; which is so situated that it is always between every two membranes, beginning with the epidermis, and ending with the last formed internal membrane.

The animals which inhabit these stratified shells, increase their habitation by the addition of a stratum of carbonate of lime, secured by a new membrane; and as every additional stratum exceeds in extent that which was previously formed, the shell becomes stronger in proportion as it is enlarged, and the growth and age of the animal becomes denoted by the number of the strata which concur to form the shell.

Although the *baliotis iris* and the *turbo olearius* are composed of the true mother-of-pearl, I was induced to repeat the foregoing experiments on some detached pieces of mother-of-pearl, such as are brought from China.

These experiments I need not describe, as the results were precisely the same.

I must,

I must, however, observe, that the membranaceous or cartilaginous parts of these shells, as of the pieces of mother-of-pearl, retained the exact figure of the shell or piece which had been immersed in the acid menstruum; and these membranaceous parts distinctly appeared to be composed of fibres placed in a parallel direction, corresponding to the configuration of the shell.

The same experiments were made on pearls; which proved to be similar in composition to the mother-of-pearl; and so far as their size would enable me to discern, they appeared to be formed by concentric coats of membrane and carbonate of lime: by this structure they much resemble the globular calcareous concretions found at Carlsbad, and other places, called *pisolithes*.

The wavy appearance and irridancy of mother-of-pearl, and of pearl, are evidently the effect of their lamellated structure and semi-transparency; in which, in some degree, they are resembled by the lamellated stone, called *adularia*.

When the experiments on the porcellaneous shells, and on those formed of mother-of-pearl, are compared, it appears that the porcellaneous shells are composed of carbonate of lime, cemented by a very small portion of gluten; and that mother-of-pearl, and pearl, do not differ from these, except by a smaller proportion of carbonate of lime; which, instead of being simply cemented by animal gluten, is intermixed with, and serves to harden a membranaceous or cartilaginous substance; and this substance, even when deprived of the carbonate of lime, still retains the figure of the shell.

But between these extremes there will probably be found many gradations; and these we have the greater reason to expect, from the example afforded by the patellæ, which have been lately mentioned.

Some few experiments were made on certain land-shells; and in the common garden-snail I thought that I discovered some traces of phosphate of lime; but as I did not find any in the *helix memorialis*, it may be doubted whether the presence of phosphate of lime should be considered as a chemical character of land-shells\*.

*Experi-*

\* Some experiments which I have lately made upon the cuttle-bone of  
Vol. VI. E the

*Experiments on the covering Substance of Crustaceous Marine Animals\**.

As I was not acquainted with any experiments by which the chemical nature of the substance which covers crustaceous marine animals had been determined, I was desirous to ascertain in what respect it was different from shell; and I began these experiments on three species of the echinus, with which I had been favoured by the Right Hon. President.

I was the more inclined to begin with the echini, because naturalists do not appear to be perfectly agreed whether to call them testaceous or crustaceous animals.

Klein, who has written a work upon echini, after having noticed the various opinions of Rondelet, Rumphius, and others, determines that they are to be regarded as testaceous animals. His words are: "Sic plurimas testas marinas, in statu naturali consideratas, cum echinodermatis potius quam cum crustis astacorum vel cancerorum conferre licebit. Itaque echinoderma cum Aristotele qui echinos inter testaceos quibus facultas ingrediendi est reponit, nec non cum Bellonio, Aldrovando, et excellentissimo Sloanio religiose testam appellamus, quam satis duram in nonnullis offendimus†."

But Linnaeus was of the contrary opinion, as appears from his definition of the echinus: "Corpus subrotundum crusta offea teelum spinis mobilibus saepius aspera ‡."

Now, as the experiments above related had proved that the shells of marine animals were composed of carbonate of lime, without any phosphate, I thought it very possible that the covering of the crustaceous animals might, in some respect, be different; and if so, I should thus, by chemical

the shops have proved that the term bone is here misapplied, if the presence of phosphate of lime is to be regarded as the characteristic of bone; for this substance in composition is exactly similar to shell, and consists of various membranes hardened by carbonate of lime, without the smallest mixture of phosphate.

\* Under this head I have included my experiments upon echini, starfish, crabs, lobsters, &c.

† Klein Naturalis Dispositio Echinodermatum, &c. p. 10.

‡ Systema Naturae. Edit. Gmelin, p. 3165.

characters, be enabled to ascertain the class to which the echinus was to be referred.

Of the three echini which were examined, one had small spines; the second had large obtuse spires; and the third was of a very flat form.

Portions of these echini were separately immersed in acetous, muriatic, and diluted nitric acid, by each of which they were completely dissolved with much effervescence; depositing at the same time a thin outer skin, or epidermis. The transparency of the solutions was also disturbed by a portion of gluten which remained suspended, and communicated a brownish colour to the liquors.

The solutions in acetous and diluted nitric acid were filtrated; after which, from the acetous solution of each echinus, I obtained a precipitate of phosphate of lead by the addition of acetite of lead; and having thus proved the presence of phosphoric acid, I saturated the nitric solutions with pure ammoniae, by which a quantity of phosphate of lime was obtained, much inferior, however, in quantity to the carbonate of lime, which was afterwards precipitated by carbonate of ammoniae.

The composition of the crust of the echinus is therefore different from that of marine shells; and by the relative proportions and nature of the ingredients, it approaches most nearly to the shells of the eggs of birds; which in like manner consist of carbonate, with a small proportion of phosphate of lime cemented by gluten.

It remained now to examine the composition of those substances which are decidedly called crustaceous; but previous to this, some experiments were made on the asterias or starfish, of which I took the species commonly found on our coasts, and known by the popular name of five fingers (*asterias rubens*.)

The asterias is thus described by Linnæus. "Corpus de-  
" pressum, subtus fulcatum; crusta coriacea, tentaculis mu-  
" ricata.\*."

When the asterias was immersed in the acids, a considerable effervescence was produced, and a thin external stratum

\* *Systema Naturæ*. Ed. Gmelin, p. 3160.

was dissolved; after which it remained in a perfectly coriaceous state, and complete in respect to the original figure.

The dissolved portion, being examined by the usual precipitants, proved to be carbonate of lime, without any mixture of phosphate; but in another species of the asterias, which had twelve rays (*asterias papposa*), I discovered a small quantity of phosphate of lime. I am therefore induced to suspect that, in the different species of the asterias, nature makes an imperfect attempt to form shell on some, and a crustaceous coating on others; and that a series of gradations is thus formed between the testaceous, the crustaceous, and the coriaceous marine animals.

It was now requisite to ascertain if phosphate of lime is a component part of the substance which covers the crustaceous marine or aquatic animals, such as the crab, lobster, prawn, and crayfish.

Pieces of this substance, taken from various parts of those animals, was at different times immersed in acetous and in diluted nitric acid; those which had been placed in the diluted nitric acid produced a moderate effervescence, and in a short time were found to be soft and elastic, of a yellowish-white colour, and like a cartilage, which retained the original figure.

The same effects were produced by acetous acid, but in a less degree; in the latter case, also, a colouring matter remained, and was soluble in alcohol.

All the solutions, both acetous and nitric, afforded carbonate and phosphate of lime, although the former was in the largest proportion.

There is reason to conclude, therefore, that phosphate of lime, mingled with the carbonate, is a chemical characteristic which distinguishes the crustaceous from the testaceous substances; and that the principal difference in the qualities of each, when complete, is caused by the proportion of the hardening substances relative to the gluten by which they are cemented, or by the abundance and consistency of the gelatinous, membranaceous, or cartilaginous substance, in and on which the carbonate of lime, or the mixture of carbonate and phosphate of lime, has been secreted and deposited.

Moreover,

Moreover, as the presence of phosphate of lime, mingled with carbonate, appears to be a chemical character of crustaceous marine animals, there is every reason to conclude that Linnaeus did right not to place the echini among the testaceous ones.

The presence of phosphate of lime in the substance which covers the crustaceous marine animals appears to denote an approximation to the nature of bone, which, not only by the experiments of Mr. Gahn, but by the united testimony of all chemists, has been proved principally to consist (as far as the ossifying substance is concerned) of phosphate of lime.

This consideration, therefore, induced me to repeat the above experiments on the bones of various animals.

It is scarcely necessary for me to mention the usual effects of acids on bones steeped in them, as they are known to every physiologist and anatomist.

In every operation of this nature the ossifying substance, which is principally phosphate of lime, is dissolved, and a cartilage or membrane of the figure of the original bone remains; so that the first origin of bones appears to be by the formation of a membrane or cartilage of the requisite figure, which, when the subsequent secretion of the ossifying substance takes place, is penetrated by, and thus becomes more or less converted into the state of bone.

It is also known that the nature of the bone is more influenced by the greater or less predominance of the membranaceous or cartilaginous part than by any other cause. It is not, therefore, for me to add any thing to this part: and in respect to the substance which is the cause of ossification, little also requires to be mentioned; for this (as has been already observed) is known principally to consist of phosphate of lime. I shall only, therefore, briefly mention the result of certain experiments.

[To be continued.]

VII. *History of Astronomy for the Year 1799.* By JEROME  
LALANDE. Read at the Lyceum on the 26th of December.

**T**HIS year will be memorable on account of the total completion of that immense operation respecting the size of the earth, which lasted seven years. Those able astronomers, Delambre and Meehan, who finished it, arrived in the month of November 1798, and by the month of January were able to give us the value of the degrees between Dunkirk and Barcelona. But, as these degrees did not follow an uniform progress, it was soon found, that, to deduce from them the value of the metre, or the new French measure, a discussion was necessary, on the oblate form of the earth, to be adopted. Had they adhered to the arc measured between Dunkirk and Barcelona, they would have had  $\frac{1}{75}$ , or nineteen leagues, for the flatness at the poles; but, by comparing it with the degree measured under the Equator, they found only nine leagues and a half.

On the 8th of April, after a long discussion, they adopted the latter quantity, and the new metre was determined to be 36 inches 11.296 lines, and the flatness of the earth  $\frac{1}{75}$ .

On the 5th of May C. Van Swinden, a celebrated Dutch philosopher, made a definitive report on the grand labour of the meridian and the metre, which was afterwards read in a public sitting of the Institute.

On the 22d of June the Institute presented to the two councils the original standards of the metre and kilogramme of platina, which were placed in the magnificent depot of the national archives in the national palace, formerly the Tuilleries.

On the 17th of November the consuls proposed a law to declare that the metre and the kilogramme are the definitive standards of France, and to cause a medal to be struck in commemoration of this grand undertaking. On one side is to be represented the Republic holding the metre and the kilogramme, with this inscription, "To all ages and all nations;" and on the exergue, "French Republic, year 7." The figure will be on a plinth of five centimetres. The reverse will exhibit

hibit the globe of the earth, a pair of compasses extended from the Equator to the Pole, the constellation of the Lesser Bear, and the following inscription—"Unity of measures, ten millionth-part of a quarter of the meridian." The diameter of the medal will be two inches, and will be executed by C. Jouffroy. It was proposed in a report presented to the Institute on the 20th of October, by C. David, Moitte, Leblond Mongez, Laplace, Delambre, Leveque and Gosselin, and was adopted by a law of December 10.

By reducing these measures to the temperature of ten degrees, which is the mean degree of the heat at Paris, and that in the caverns below the observatory, I find the 45th degree to be 57012 toises, instead of 57031 which I had adopted in my astronomy. This is 19 toises less; the mean radius of the earth 3268159 toises, less by 1323 toises than my table, which hitherto has served as a rule in books of natural philosophy. This, without doubt, is very little in regard to the extent of the earth: we are therefore pretty well acquainted with its size, but we are not sufficiently acquainted with its irregularities; and this, at any rate, is one important result from this new labour.

This year has furnished three new comets. On the 6th of December 1798, C. Bouvard discovered, at the observatory, a small one in the constellation of Hercules; it was seen only during six days, and disappeared on the 11th of December in Aquarius, but C. Burckhardt calculated its orbit with all the precision possible\*.

C. Meehan, to whom we are already indebted for the discovery of so many comets, found one on the morning of the 7th of August, which is the 90th according to the general catalogue in the third edition of my Astronomy. It was very small and without any tail, but exceedingly clear; it was above the Lynx, in the constellation which Hell formed in 1790, under the name of the Grand Telescope of Herschel. At three o'clock in the morning it had  $107^{\circ} 47'$  of right ascension, and  $43^{\circ} 54'$  of north declination. It was among the stars which C. Lefrançais observed on the 9th of March 1794, so that very exact positions were immediately obtained.

\* *Connoissance des Temps*, an. 10. p. 380.

C. Meehan

C. Méchain and C. Burckhardt each calculated the orbit with that ardour and readiness which are natural to these able astronomers: C. Messier followed its progress, according to his usual custom, with indefatigable assiduity, for more than two months, till the 25th of October, when it disappeared on the eastern knee of Ophiuchus. During this long appearance our collection of 50,000 stars has often furnished important points for the reduction of these observations. On the last day it was near a star of the sixth magnitude, the position of which I have given in the *Connoissance des Temps* for the year 10. All the observations of C. Méchain and Messier will be published in detail: some of them have a wonderful degree of perfection, because they were made by means of an excellent meridian telescope, at the *Maison du Champ de Mars* (Military School) by C. Lefrançais and Burckhardt.

This day also, December 26, 1799, at half after five in the morning, C. Méchain discovered a new comet in Ophiuchus, which will be the 91st. It had about  $26^{\circ}$  of right ascension and  $5^{\circ}$  of northern declination. It appeared to the naked eye as a star of 5th and 6th magnitude in the telescope. Its nucleus was exceedingly luminous, and almost bounded: it had a very narrow tail, of a pretty intense light, and about  $7^{\circ}$  in length. It advanced towards the south so rapidly that it was apprehended it could not long be observed, unless it should appear in the west after having traversed a part of the southern hemisphere.

As the most defective part of astronomy at present is what relates to comets, I must recommend them to all our correspondents. The Bureau des Longitudes has sent a night telescope to C. Flaugergues at Viviers, who has promised to make use of it.

C. Mougin, in the department of Doubs, has promised the same thing; but, being a priest, he was obliged to quit La Grand'Combe-des-Bois, where he was curé, and where, since 1766, he had made many observations and calculations, and had been banished to a hollow valley where he could no longer have a proper view of the heavens. The government has thought proper to suffer him to resume his labours, and

to return to his ancient habitation, which is more convenient for searching out comets.

To render this search more successful, I have proposed to mount a Newtonian telescope in such a manner as to be moveable around the eye-glass, by means of a handle, without changing the place of the eye. M. Von Zach has caused this machine to be engraved, and I hope that, at a more favourable period, it will be executed, and be the means of discovering new comets. If, in the course of forty-three years, the same number has been discovered by searching for them with plain telescopes without any support, how many ought we not to find by the method I propose, which will not suffer the least portion of the heavens to escape observation?

C. Pictet, the celebrated professor of natural philosophy at Geneva, and director of the observatory, has sent us the drawing of an English telescope, which, with a hinge and small arch of copper, becomes parallactic, and proper for following the stars, and for making the greater part of astronomical observations. I hope opticians, who make stands for telescopes, will take advantage of this hint, since mere amateurs, with an achromatic telescope, will thus be enabled, without farther expence, to find out and to follow stars in the open day, and to search for comets, of which we at present stand in need.

The great work on the stars, which I began in 1789, has been carried by C. Lefrançais to nearly 50,000, notwithstanding the unfavourableness of the seasons, which has rendered this year one of the most disagreeable and unfruitful seen at Paris. These stars have been already printed in my *Histoire Céleste*, the first volume of which, as well as my *Bibliographic Astronomique*, will appear as soon as the state of the finances will admit of funds being applied to the printing-house of the Republic. C. Burckhardt has continued to make, with C. Lefrançais, a great number of important observations on the planets and stars; for, as there are two excellent instruments at the Maison du Champ de Mars, these are sufficient to employ those two able astronomers.

Madam Lefrançais has made for the *Connoissance des Temps*

Times of the year 10, which has just appeared, and that of the year 11, now printing, catalogues of 3000 stars reduced and calculated: she has therefore given us in the whole 10,000. But C. Burekhardt has made tables of a new form, which will enable him to calculate with ease the whole of the 50,000 stars which have been observed.

The obliquity of the ecliptic being one of the fundamental objects of astronomy, we have continued to observe it at the two solstices of this year. We found it in the month of June 5" more than what is given in my table; but C. Méchain, in the month of December, found it 8" less than in my table. This difference arises probably from the refraction in winter, which is not yet sufficiently known. This question we hope to resolve in the present year by comparing better the two solstices.

The observatory was in want of good instruments, but we have at length been able to obtain some. The large mural quadrant of C. Lemonnier, which General Bonaparte procured for us, has been erected, as well as that of five feet, which C. Lemonnier lent me in 1751 to observe the moon with at Berlin, and an excellent meridian telescope executed by C. Lenoir, with an object-glass by C. Caroché. The latter made also the large speculum of the twenty-two feet telescope which was at La Muette, and which was equal to that of Herschel of the same length. The telescope of platina, which they wished to take from us, has been secured to the observatory by a decision of the minister of the interior. Thus nothing is wanting to the most beautiful observatory in the world, to render it at the same time the most useful.

We hope at the Peace to have a telescope of forty feet, with specula of platina. On the 7th of August, 7th year, a decree was made by the Institute that the platina we have should be reserved for the large telescope until we obtain from Spain a greater quantity. We have already 200 pounds, but we must procure at least 2000 for the speculum, which the intimate connection between France and Spain gives us reason to hope will be the case.

Mr. Brown, an ingenious optician of London, has made telescopes,

telescopes, the tubes of which always remain horizontal, and in which the image of the object is thrown on the eye-glass by means of a plain speculum.

The Minister of the Marine has augmented the salary of the Astronomers of the Marine at Marseilles, and C. Thulis has resumed his observations with new zeal. The observatories of C. Darquier at Toulouse, Duc-la-Chapelle at Montauban, and Flaugergues at Viviers, have furnished us with many useful observations.

The grand and important work of C. Laplace, entitled *La Mécanique Céleste*, expected with so much impatience, appeared on the 6th of September. In that work will be found the methods and noble analysis which led the author to the important discoveries which I have several times announced and extolled in this history.

C. Burckhardt translated it into German with explanatory notes, at the same time that he read the proofs of the French edition, and went over all the calculations. No author ever had, or was more worthy of having, a translator of so great merit. The *Bureau des Longitudes*, who had long known the zeal and ability of C. Burckhardt, have unanimously elected him to a place vacant three years, though it had been solicited for by several men of letters, of approved talents, and natives of France. But C. Burckhardt has got himself adopted by France; he has preferred it to his own country, which he will no less honour by labouring with us. In the last century, Cassini, Huyghens, Romer, and Maraldi, came in like manner to reinforce astronomy in France; but at that period it had more need of such assistance. There were then only two or three French astronomers; at present we have seven or eight.

M. Schubert has published in German, at Petersburgh, a work on Physical Astronomy in two volumes quarto, in which are found calculations of the perturbations of all the planets.

C. Caussin has finished the translation of the Arabic manuscript of Ibn Iunis. In this work there are more than a hundred observations, thirty of which are of eclipses. I had found a fragment of it among the manuscripts of Joseph de Lisle, my old master.

The Institute decreed, on the 2d of December, that the Minister for Foreign Affairs should be requested to borrow at Leyden the manuscript of Ibn Junis, in order that the Arabic text might be printed; and we have reason to believe that this request will be granted.

C. Bouvard has calculated the Greek and Arabic eclipses, and found that  $3' 13''$  must be added to the anomaly,  $8' 30''$  to the secular movement of the anomaly of the moon, and a minute to the supplement of the node for 1790, and that its secular movement must be diminished  $2' 48''$ .

C. Laplace has determined by theory two equations of the moon. Two long memoirs, transmitted to the Institute in consequence of the prize we proposed, contain many observations and calculations on the same subject. This part of our tables, therefore, so interesting to navigation, has acquired this year a new degree of perfection.

On the 8th of May we observed, for the 17th time, the transit of Mercury over the Sun's disk. It is the first ever completely observed at the descending node, and there will not be another of the same kind till the expiration of thirty-two years. It was impatiently expected by all the astronomers. It was observed throughout all Europe; and C. Delambre has drawn up a work, with new formulæ, in order to deduce from the transits of Mercury all the consequences thence resulting.

C. Vidal, our real Hermophilus, has made at Mirepoix a new series of observations of Mercury in all parts of his orbit; so that we want nothing more in regard to this planet, so difficult to be seen in our climates. This astonishing observer has sent us observations also of more than a thousand austral stars, which can scarcely be seen at Paris on account of their small elevation.

The Ephemerides of Milan for 1799 have furnished us with a new series of observations of Mercury by C. Cesaris. In these I have the pleasure of finding that the errors of my tables are almost insensible. I have had the same satisfaction in regard to the digression of Mercury in his aphelion on the 12<sup>th</sup> of August. The distance of the sun, and the eccentricity

eccentricity of that planet, were found to correspond with my tables, except a few seconds.

The inferior conjunction of Venus, on the 16th of October 1799, was a phenomenon also of importance for the theory of this planet. It takes place only every eight years in that part of her orbit. It was observed with as much assiduity as success by C. Lefrançais and Burekhardt, in my observatory at the *Maison du Champ de Mars*. I have compared it with that of 1751, which was in the same position, and for which I had made a great number of calculations, and I have found scarcely any thing to be changed in the elements which served for the construction of my tables of Venus, published in the third edition of my Astronomy in 1792. This labour will be inserted in the Memoirs of the Institute.

On the 23d of November this beautiful planet was eclipsed by the moon. This phenomenon would have attracted a number of eyes, had it not been at four o'clock in the morning. Jupiter, which is not so brilliant, drew together a great crowd at the *Palais Royal*, on the 14th of March 1788, to see him on the point of being eclipsed.

Observations of Jupiter have proved that about  $30''$  are to be added to the tables, which shews that we ought to make a little addition to the mean motion: this I before proved in discussing the ancient observations in the Almagest of Ptolemy. The opposition of the 16th December 1799 gave me 30 seconds. C. Quenot, an able navigator, who has returned from Egypt, observed it with an astronomical circle, and obtained the same result. The latitude also was found too small by  $15''$ ; from which I conclude, that the longitude of the node of Jupiter, which is in the tables of C. Delambre, in the third edition of my Astronomy, ought to be diminished  $10'$ .

The tables of Mars are those most deficient. C. Lefrançais, therefore, has been employed on them for some months. He has calculated all the oppositions and quadratures hitherto observed with accuracy, and the result will be tables more accurate than any ever yet given, in which there will be only a few seconds of uncertainty. C. Burekhardt has calculated the

perturbations

perturbations of Mars by the action of Jupiter and the Earth, which Schubert and Oriani had before calculated, and without which we could not have hoped to carry our tables to the same degree of perfection.

The collection of observations made at Greenwich by the celebrated Bradley and his assistants between 1750 and 1762 has appeared in England, but I have not yet been able to procure it.

Miss Herschel has published a volume on the stars, not of observations, but researches respecting the grand British catalogue of Flamsteed, and the observations of that celebrated astronomer; where she has found 500 stars which are not in the catalogue, as she has found many in the catalogue which are not in the observations.

C. Kramp, Professor at Cologne, has published an analysis of astronomical refractions, in which he has been able to determine the refraction accurately and algebraically without employing any hypothesis or approximation. This work leads us one step farther in this difficult part of astronomy. It was proclaimed, with the other important works of the year 7, at the last exhibition at the Museum.

The Academy of Stockholm has sent M. Swanberg to Lapland to find out the stations which served in 1736 for measuring a degree under the polar circle. He employed himself only in discovering their local situation; but he says he found two minutes error in the reduction of the stations to the horizon, which might have arisen from some defect in the instruments, or from terrestrial refraction. I have been informed in a letter from Sweden, that Maupertuis proposed to recommence the measurement at his own expence. This proves that he was not entirely satisfied with the result, which differs considerably from many other degrees that have been measured. The local inequalities of the ground, however, may have been the cause of this diversity.

C. Defortia, as well skilled in Greek as in Geometry, has made a new translation, with learned notes, of the book of Aristarchus of Samos, respecting the distance of the sun and the moon, collated with ten other manuscripts. This celebrated

brated work contains the noblest idea ever formed respecting the manner of finding the distance of the sun from the earth : an idea which, in my opinion, surpasses all those ever entertained by the greatest astronomers. I gave some account of it in the *Journal des Savans* for 1797 \*, of which only twelve sheets were published between the 5th of January and the 20th of August.

The Nautical Almanack for 1803 has been transmitted to us by the care of Sir Joseph Banks, President of the Royal Society, to whom we owe this public testimony, that since the commencement of the war he has maintained the intercourse of the sciences. His name, his credit, and his fortune, enabled him to overcome all obstacles, and to remove every political impediment ; for we have asked nothing from him which he has not taken the earliest opportunity of granting. The Minister of the Marine renders the same testimony, and acknowledges the favours he has received from Sir Joseph Banks.

Five volumes of the Asiatic Researches have been published at London. They contain a great many observations made by the English in different parts of India ; together with memoirs on the Indian astronomy, the lunar year, and the worship of the Indians.

Baron Humboldt has gone to Mexico with instruments and a chronometer by Berthoud, and we hope to receive from him interesting observations respecting the geography of a country almost unknown. He will employ himself also on natural history, a subject with which he is well acquainted †.

C. Nouet published in the *Décade du Caire* several observations made in Egypt ; and general Bonaparte has caused them to be reprinted at Paris by Didot. C. Nouet informed me in a letter, that he was going to proceed up the Nile as far as the Tropic, where the famous wells of Syéné are situated, and where no shadow is observed in the day of the solstice. We shall therefore have a real geography, ac-

\* Page 106 and 203.

† Two letters from M. Humboldt will be found among the Intelligence for this month. EDIT.

companied with other observations of those famous countries which gave birth to astronomy, and where it has been forgotten for 2000 years.

C. Castera has given us, in two volumes 8vo. a translation of the curious travels of Mungo Park into the interior parts of Africa; and we at length know the real direction of the Senegal and the Niger, of which, after six months research, I made only one river in my Memoir on Africa, printed among those of the Academy of Sciences for 1790, the last volume of that collection.

C. Montucla has given a new edition of his History of the Mathematics, enlarged by one-half, and in which astronomy occupies a considerable place.

In the National Library there has been found a manuscript on Optics by Ptolemy, which was supposed to have been lost. It is a Latin translation from the Arabic. C. Caussin, by whom it was found, proposes to make known this valuable manuscript.

M. Bode has sent us from Berlin the remainder of his large and beautiful charts which represent the heavens. The great number of stars with which I furnished him, gave me a right to new constellations. To fill up the vacant spaces he had put thirty-three animals in the heavens; and I have added a thirty-fourth, *viz.* the Cat, on account of that charming poem, of which Desherbiers has published some fragments. This new constellation of the Cat is between Hydra and the Ship. It has been already engraved in Germany, and will be inserted in M. Bode's new Celestial Atlas, of which he has published twelve sheets.

M. Hobert and Ideler, of Berlin, have published Logarithmic Tables for the decimal sines, which will facilitate astronomical calculations, until the more extensive tables, which C. Proney caused to be calculated at the *Bureau du Cadastre*, and which began to be printed some years ago, are finished.

The stereotype edition of Logarithmic Tables, published four years ago by Didot and Callet, which ought at length to be free from all faults, has been corrected on the plates, and there is reason to think that they approach very near to perfection.

We wanted also small portable tables, and these C. Didot has undertaken. I have begun an edition of Logarithms carried to six decimal places, like those given by myself and Lacaille in 1760, which were published by Marie in 1768, and reprinted four times afterwards, but still with more faults than the first time. We at length, however, have a permanent edition, which it will not be necessary to reprint every ten years with more errors than those before discovered.

M. Bogdanich, assistant at the observatory of Buda, has made, in several cities of Croatia, observations of great importance to Geography.

[To be concluded in the next Number.]

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VIII. *Description of a singular Phenomenon in a Thunder-Cloud.* By L. C. LICHTENBERG \*.

ON a summer's day, exceedingly hot and sultry, the barometer being at 27 inches seven lines, and Reaumur's thermometer at  $22\frac{1}{2}$ , there was formed, about three in the afternoon, to the north of Gotha, a dark thunder-cloud, having the appearance of rocks piled upon each other, and in shape almost like a mushroom. (Plate 1. Fig. 1.) The magnificent spectacle exhibited by this immense mass floating in the blue expanse of the atmosphere excited my attention; and I soon observed, that, from the small part which represented the stem of the mushroom, there arose a fine bright vapour, which in a few moments formed a perfect ring around this part of the cloud. The ring seemed to be in violent agitation, by which it became always more enlarged, so that in the course of a minute it exceeded the greatest breadth of the upper part of the cloud. It then began to extend itself upwards and downwards, and in less than thirty seconds the whole cloud was enveloped in a transparent covering, (Fig. 2.) This phenomenon had scarcely continued a minute when the cloud began to extend itself, as if by a current of air forced from its interior, and to assume the form of a fan. It now lost its smooth rim, which terminated, as it were, in fringes,

\* From *Magazin für das Neueste aus der Physik*, Vol. I.

and the whole acquired the form of a thunder-cloud. Some minutes after, black rainy clouds, formed of the vapour driven downwards, and of the remains of the covering, were collected below; and I expected every moment to see the first flash of lightning, which soon followed. A little rain fell at some distance, but within a quarter of an hour the cloud was so distended that it was soon lost in a thin mist. The same phenomenon, though not so striking, I have since seen in a great many other thunder-clouds, but inverted. Instead of a fine vapour being thrown out, and forming a covering, I saw white clouds sink down, spread themselves out like a veil over the arched part of the cloud, and disperse themselves in it. The reason why the vapour thrown out from the cloud here described formed a ring, was its singular form. The vapour, by being forced out on all sides, was so compressed that it could extend itself only edgeways, and afterwards diffuse itself round the cloud.

If this phenomenon be compared with the electric experiment where a ball of cotton, suspended by a silk thread, is introduced into a metal vessel of a cylindric form and sufficient width, and where the vessel is sometimes rendered electric and sometimes deprived of its electricity, the idea I mean to convey by this description will be readily conceived. I am of opinion that I can thereby prove that we might examine the electric state of the upper regions of the atmosphere, and even of the clouds, with accuracy, if the latter were observed more frequently than has hitherto been done, and were they employed as natural electroineters for this purpose.

*IX. Observations on the Elk. By the late E. H. SMITH,  
Physician\*.*

THE accounts hitherto published by Naturalists, of the Elk and the Moose, two very remarkable animals of the deer kind, are confused and unsatisfactory. Beside the misapprehensions which they contain relative to both animals, all the difficulties in the way of obtaining just notions con-

\* From the *American Medical Repository*, Vol. II. No. 2.

cerning

cerning them have been increased by the writers of zoology having confounded one species with the other. Another source of error *probably* exists in some real dissimilarity between the elk or moose of Europe, and the elk and moose of North America.

The description of the moose-deer by Mr. Dudley, (*Philosoph. Transf.* No. 368, p. 165.) I have every reason to believe, is correct as far as it goes; but it applies strictly to the moose, and not to the elk, which is a different animal.

M. De Buffon (*Histoire Naturelle, L'Elan et Le Renne,*) appears, in several places, to have mingled the descriptions of both animals, and certainly considered elk and moose as two names for the same creature. And this is the more remarkable, as the several quotations which he has made from different authors contain manifest contradictions; as will be evident to any person who has seen either the moose or the elk \*. The reader of M. De Buffon, therefore, will not be surprised if he obtain no clear notion of the Elan; as it is not probable that the illustrious author himself had a distinct conception of the subject of his description.

In Mr. Snellie's translation of Buffon, Vol. VI. p. 350, &c. there are several additions to the original article. The animal and head of an animal, mentioned by Mr. Allomond, were probably of the moose kind.

Dr. Goldsmith (*Hist. of the Earth and Anim. Nature, art. Elk,*) acknowledges the discordancy of the various histories of the elk, which he also supposes to be the same with the moose; and he labours, very ineffectually, to reconcile the descriptions of authors. The figure given by him resembles neither the elk nor the moose; and the reader will conclude the Doctor's account with as little satisfaction as he appears himself to have done, when he says, "After all, this animal is but indifferently and confusedly described by authors," &c.

\* See p. 543, Tome III. p. 2, edit. 8vo, à Paris, 1775. The description (inserted p. 554 of the same edition), copied from the *Memoirs of the Academy of Sciences*, is of the European elk, and resembles the moose more than the elk of America; to which, however, it bears a greater likeness than is observable between this last and the moose.

The confusion and contradictions of preceding writers have been supposed to be avoided or removed by the celebrated Mr. Pennant in his *Arctic Zoology*; a work to which those who are better able to judge on such subjects than I am, ascribe transcendent merit. In this work (Vol. I. p. 19, art. Moose,) the author pronounces "the elk and the moose (to be) the same species; the last derived from *Musu*, which, in the Algonkin language, signifies that animal." And this opinion seems to have been quietly acquiesced in; and the substance of Mr. Pennant's account has been copied into the *Encyclopædia Britannica*, and perhaps into other works of equal credit and circulation.

An opportunity having been presented to me, of satisfying myself that Mr. Pennant has erred in describing the moose and elk as a single animal, I think it my duty to correct this mistake of that learned and amiable naturalist; and I am too well convinced of his love of truth and ardour for the advancement of natural knowledge, to doubt of his receiving my correction with candour and delight. It may be proper for me to premise, that, from the best information that I can obtain, (and I have had occasion to converse with several persons who professed to be well acquainted with both the elk and the moose,) the history which has been given of the moose by that gentleman is essentially just in every other respect than what relates to its identity with the elk.

IN August and September 1797 I visited repeatedly, in company with Dr. Mitchill, Dr. Miller, Mr. Dunlap, and other gentlemen of my acquaintance, four elks, then exhibited in this city for gain. Two of them were males, which the keeper assured us were but two years and a few days old; one a female, somewhat more than three years of age; the fourth a male fawn, a year old. They were taken separately, a few days after their birth, and had been reared by men for the purpose above mentioned. They were very docile, and might be handled and examined with perfect safety.

*Colour.*—In this they all exactly resemble each other. In the spring the colour of the hair is reddish; it then changes to a greyish dun (which was its appearance when observed by

by us); and in autumn, to a grey, which continues through the winter. The rump is of a pale yellowish white, the colour extending about six or seven inches from the tail, on all sides, and very distinct from the general colour of the body. A black semi-circular line, of unequal width, (from 2 to  $\frac{1}{2}$  inches,) separates the white of the rump, on either side, from the dun or grey of the body. The forepart or shin of the legs, and the nose, are black. The under-lip is fleshy, and marked, in all four, in an uniform and peculiar manner. Near the cheek, on each side, it is black; and a black stripe divides it equally underneath: the rest is white.—The male has a short mane, about two inches longer than the rest of the hair on the body. At this time the hair was very short; but in winter it is said to be four inches in length, and the mane six, and of the colour of the body. The male also has a beard, or covering of hair, under his throat and upon his breast, which, though short in summer, grows out, in the course of the autumn, six or more inches beyond the hair of the body; and is then, as now, of a deep black colour. This beard is wanting in the female. The male sheds it every spring,

*Head.*—The head (as will be seen Plate II.) resembles that of the common deer, and of the horse, much more than that of the moose, and is pointed and handsome. The neck is rather long and handsome.

The elk has an oblique slit or opening under the inner angle of each eye, externally, of near an inch in length; which is said to communicate with the nostril \*. But this we could not correctly ascertain by examination, though there seems no reason to doubt the fact. Something of the same kind obtains in the fallow-deer, supposed to be analogous to the *puncta lacrymalia* in the human head. (See Mr. White's Nat. Hist. of Selborn: see also Encyclopædia, art. *Cervus*.) A like opening is noticed by Sparman, and

\* Mr. Campbell, of Richmond, Virginia, informed me, that in the skeleton head of an elk, which he had seen, the opening under the eye, communicating with the nostril, was so large that the thumb might be easily introduced into it.

supposed

supposed by him to answer the purpose of facilitating free respiration, in the Cervine antelope, (*antelope bubalis* of Pallas.) See Encyclopædia, art. *Capra*.

The use of this opening is differently explained by the proprietor of the animals here described. He assures us that the elk possesses the power, by strictly closing his nostrils, of forcing the air through these apertures in such a manner as to make a noise which may be heard at a great distance; that he has seen the wild animals do this frequently; and that the design of it is to alarm each other when they suspect any danger near. He has taught those in his possession to make a similar noise; but it was too feeble to cause any observable dilatation of the slit.

If the above explanation of the keeper of these elks be just, it will probably lead us to a more accurate notion of a circumstance related concerning the *Rupri Capra*, or Chamois of the Alps, of whom it is said, that "when he smells or hears any thing which he cannot see, he *whistles*, or *blows*, with such force that the forests and rocks re-echo with the sound."—See Encyclopædia, art. *Capra*.

*Horns.*—The female has no horns. The appearance of the horns of the fawn exactly resembles those on the head of the principal figure (opposite p. 18.) given by Mr. Pennant.—The males (as the keeper informed us) drop their horns annually, in May, then leaving a pith about four inches in length, which is soon covered and protected by velvet. In eight weeks the horns began to grow again. In the animals we saw, they had been growing about eight weeks. On our first visit, the horns were uniformly covered with a smooth velvet. About ten days after, the velvet was coming off in narrow strips, leaving the horns bare. By the middle of September they were entirely free from it. The keeper informed us, that the animals freed their horns from it, when wild, by rubbing them against trees. Now they derived the same aid from the posts, &c. of their stable; and the proprietor occasionally assisted them. It was observable that a small oozing of bloody lymph sometimes succeeded the removal of a strip of the covering.

The horns of the elk, instead of being palmated, as are those of the moose, consist of three principal divisions:—  
 1. The brow antlers, which the hunters call the *altars* ;  
 2. The two middle prongs, called the *fighting-horns* ; and  
 3. The *horns*, properly so called. The two first retain their simplicity, the last increases in complexity every year. They do not, as those of the moose are said to do, acquire a new branch every year; though something analogous actually occurs. When the animal enters his third year, a single prong or point comes out on the inside of the left horn; the next year, a similar point on the inside of the right horn; and so alternately. Four short points, called *pikes*, were now apparent, one on each brow-anter, and one on each fighting-horn. They seldom exceed an inch in length.

The following measurements were made of the horns of one of the male elks. They were somewhat longer than those of the other, notwithstanding an inch or two had accidentally broken off from the end of one of them.

F. Inch.

Distance between the roots or origin of the horns,	○	4
Brow-antlers	- - - - -	1 6
Fighting-horns, not measured, but about the same.		
Longest horn	- - - - -	3 0
From the tip of one horn to that of the other	2	6

I recollect to have seen, in the Museum of Yale College, New-Haven, Connecticut, some years ago, a remarkable pair of horns, supposed to have belonged to a moose or elk. They were not palmated; and though I had not at that time devoted any attention to subjects of natural history, yet, from the general idea which I retain of their figure and composition, I am persuaded that they must, at some period, have ornamented the head of an elk. If I am right in this particular, it will afford us some notion of the size to which the horns of this animal attain. The horns in the Museum of Yale College, if I do not misremember, were said to weigh 55 or 56 pounds.

*Size.*—As the animals now described had by no means attained their full growth, it is impossible to give any precise

information concerning it. The measurement made of them in their present state are as follow:—

	F. Inch:
Length of the male, from the tip of the nose to the tail, along the line of his back, (the males were nearly of a size,) - - - - -	7 3
Of the female, (a year older than the male,) - - - - -	7 9
Height - - - - -	4 7
Round the girth or belly - - - - -	5 6
— the withers - - - - -	4 10
Length of the head - - - - -	1 11
— tail - - - - -	0 3
From the extremity of one ear to that of the other - - - - -	2 2
Length of the ear - - - - -	0 9

The brisket of the elk very much resembles that of the ox.

*Place and Food.*—The elks which were exhibited here were brought from Upper Canada. They are said to be found in almost all the back country of the United States, as low down as Virginia. In respect to food, as these had been domesticated from infancy, nothing particular could be learnt from them concerning what they most affected in the wild state. What appeared remarkable to us was, that they all ate tobacco, as variously prepared by the tobacconist, with greediness. This, the proprietor assured us, was a natural appetite; and that the wild elks ate the wild plant. We thought that this required further evidence; notwithstanding, we are informed by Hasselquist, that the *Cervi Capra* of Barbary “ loves the smoke of tobacco, and, when caught alive, will approach the pipe of the huntsman, though otherwise more timid than any animal.” *Encyclopædia, art. Capra.*

*Young.*—The rutting-time is from about the 20th of September to the 1st of October. The female goes about nine months; generally brings forth twins; and it seldom happens but that one is male and the other female.

*Gait, &c.*—The hoofs of the elk are very much cloven, and, like the moose and rein-deer, he makes a great clattering with them in travelling. He is very fleet. A stranger, who was viewing these elks at the same time with us, told

us,

us, that he had seen elks used in sleighs the last winter; and that they were easily managed, very strong, and very serviceable. He represented them as travelling at the rate of 18 or 20 miles an hour. It is possible that it was the rein-deer that he saw used in this manner in Canada.

*Flesh and Skin.*—The flesh is said to be excellent, and the skin employed for various useful purposes.

*Oil-Spring.*—On the outside of each hind leg the elk has a small vesicle or bag, which contains a thin unctuous substance that the hunters call *oil*, and the bag the *oil-spring*. The male is said to open this, by means of his horn, as the horns begin to grow; when the oil spreads over the young horn, and is supposed to nourish and protect it. This he does regularly, the keeper informed us, at 10 P. M. and at 4 A. M. The female has not been observed to make any use of this oil, except when wounded. She then, it is said, opens the bag with her tooth, and applies the oil, by means of her tongue, to the wound.

In rutting-time the elk is represented as contriving to throw his urine upon this vesicle; which inflames in consequence, and emits a strong scent, whereby the animals discover each other in the woods. With regard to the superstitious notion concerning the elk's curing himself of the epilepsy by means of his hind hoof, &c. (See Pennant's Arctic Zoology, art. Moose,) may it not be probable that the belief originated from the use he makes of the oil-spring, of which the earliest European writers might be ignorant?

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X. *Extract from a Letter of Mr. J. TURNER to Dr. PEARSON, on the Practice of the Vaccine Inoculation among Country-People.*

**I** AM informed by our dairy-people, that the cow-pock is epi-bootic chiefly in the spring among cows about April or May, and that the spurious sorts prevail in common at almost every other time; and as the spring is now advancing, I shall have it in my power to assist you. Believe me, Sir, that the cow-pock mania is as great in the country as in the metropolis.

Perhaps you would like to know how we carry on the vaccine inoculation: almost every cobler, shepherd, and cowboy, are consummate and experienced adepts in this new specific art.

I will, with your leave, intersperse this with a remark to substantiate what I mean to advance.—At Steeple Claydon, a village five miles from Winslow, great numbers have been inoculated for the vaccine disease by the most illiterate of all beings in human shape—the cow-boys and shepherd's boys, without any prior or subsequent medicine whatever. At Westbury, Shenley, Fattenhoe, and a number of villages round our neighbourhood, the same. At Finmere, Mr. Holt, the clergyman, (a neighbour of ours,) does administer some little medicine, such as salts, &c.—People are inoculated, and inoculate themselves, indiscriminately; such as farmers, dairy-people, &c. with impunity, without any preparation, subsequent purification, or making application to any medical person whatever. Yesterday I saw a man inoculate a family with a cobler's awl dipped in another's arm: others do it with a penknife ground like a lancet point: others with needles infected with the vaccine matter. I am a great advocate for the vaccine inoculation: I acknowledge it to be a great acquisition and discovery, and consequently ultimately a great blessing to the community at large, and do not doubt of its success.

The well-attested facts that you and others assert, prove it indubitably; but greatly do I lament that some delusion, or some secret mysterious means have not been *put in force* to prevent its being in other hands than medical men. The small-pox inoculation is now rapidly declining, and probably in a few years may be known no more. I am sorry to say, that some of our rustics appear to understand the cow-pock better than many of our country medical fraternity. I may add, Farewel, Thistle Forest! Farewel, Primrose Hill, Stanton House\*, &c.

N. B. The proprietors of the above houses deny the vaccine disease to be a specific for the variolæ; but the inter-

\* The houses alluded to are small-pox inoculation houses, of great repute.

pretation is obvious, because the new inoculation will not supply them with patients.

I was treated with some derision the other and am every day: a person said, that, as he had inoculated many for the cow-pock, he knew the complaint, and its treatment, better than myself.

I am greatly sorry the disease above spoken of is so well known among the cow-people, as many eminent men will lose great sums in the year by the small-pox being superseded.

*Query*, Whether Fame, with her babbling tongue, some future time, may not convey rustic vaccine intelligence to some metropolitan friends, and so overturn your excellent Institution, which, I am informed, is on the tapis\*?

Dear Sir, believe me,

With the greatest deference and respect,

Your most humble Servant and Pupil,

*Winslow, Bucks.*

J. TURNER.

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XI. *Extract of a Memoir on Elasticity.* By C. BARRUEL †.

THE author of this memoir endeavours to explain the cause of the elasticity of bodies by the help of caloric. After laying it down as a principle, that this fluid is eminently elastic; that it is interposed between the integrant moleculæ of bodies, which is proved by their porosity; he hopes, from these two principles, to deduce consequences leading to this result. But whatever may be assigned as the cause of elasticity, caloric, at any rate, has a great share in the phenomena which it exhibits.

The different systems adopted by philosophers respecting the cause of elasticity, are, in the author's opinion, either vague or evidently erroneous. It cannot, he thinks, be ascribed to a repulsive force, with which the moleculæ are endowed, and which increases as they approach; for the

\* It appears, by the vaccine inoculations in the country, that medical assistance was scarcely necessary.

† From the *Annales de Chimie*, No. 97.

existence of this force is merely hypothetical. Nor can it be said that the elasticity is owing to air interposed between the moleculæ, since the phenomena of elasticity manifest themselves in vacuo.

C. Barruel is of opinion, that if we should ascribe the cause of elasticity to caloric, this question would remain to be answered, Why is caloric so eminently elastic? We know, indeed, says he, that the affinity of moleculæ of water to those of sponge, into the pores of which they introduce themselves, produces an increase of the volume of that sponge; but the cause of the reciprocal attraction of these different moleculæ remains unknown. Besides, we could not refuse to admit that the elasticity of caloric would arise from the property which the moleculæ of this fluid might have of repelling each other: a property the more probable, as it is observed in the electric fluid, with which caloric has so great an analogy. In a word, we may be satisfied with admitting its elasticity as a fact from which we set out, as from an incontestible principle,

The author then proceeds immediately to his object, and examines in what manner caloric acts upon bodies. It dilates them by means of a reciprocal affinity between it and their moleculæ. These affinities are variable; but it is certain that, in regard to the same substance, they decrease in proportion as the distances increase, and that their action is at length reduced to zero.

Now, if we suppose a given quantity of caloric inclosed in a receiver incapable of acting on this fluid, it will every-where diffuse itself in an uniform manner. If we then introduce a molecule of matter, the caloric will be unequally condensed around it, in virtue of the unequal action which it exercises on the parts of the fluid at different distances from it, and it will be surrounded by a kind of igneous atmosphere, composed of strata of different densities. If a second molecule be introduced, the same effects will take place, and every thing will remain in the same state as long as the molecules are at a distance from each other equal to the diameter of their atmospheres; nothing is changed but the temperature. But when the moleculæ are brought so near each other that

their

their distance is less than that diameter, their atmospheres will be compressed, and the parts in contact will assume more density and a higher temperature, and which is not in equilibrium with that in the rest of the receiver. These parts deprive themselves of a portion of their caloric, which is distributed among the other strata of these atmospheres until the equilibrium is restored.

When the moleculæ are made to approach each other gently, the compression of the atmospheres and their re-establishment take place peaceably; but if the moleculæ are brought into contact abruptly, the caloric is disengaged with the greatest violence. It is to this rapid disengagement of caloric, strongly compressed, that we ought to ascribe the detonations of the super-oxygenated muriat of pot-ash and of gun-powder.

The moleculæ assumed, for example, retain a portion of the compressed caloric as long as they obey the force which makes them approach each other. When they arrive at that distance at which they exercise an action on each other, their attractive force is greater or less than that with which their atmospheres tend to recover their former state. If the moleculæ, then, be left to themselves, in the first case the system retains its present state; in the other case it will resume its primitive state; and it is in this that the greater part of the phenomena of elasticity seem to consist. This reasoning may be applied to every body, the moleculæ of which are separated from each other by a certain quantity of caloric.

C. Barruel pays attention also to the circumstances under which the elasticity of a body may be manifested, and to the means proper for increasing or producing this property. These circumstances are, compression, a sudden shock, and flexion. In either of these circumstances it happens that the adherence of the moleculæ either is or is not overcome. In the first case the moleculæ are put out of their sphere of activity, and the body is said to be brittle. In the second case the body is flexible, but the caloric interposed between its moleculæ withdraws, or does not withdraw itself, from compression. If it withdraws itself, there is only one dis-

placement of the particles of the body, which is then said to be ductile. If it cannot withdraw itself, it yields or resists. When it yields, the body is soft; when it resists compression, it experiences the effects of it as long as the moleculeæ are compressed; it then tends to recover its former state; and this is what renders bodies elastic.

There is no body perfectly soft, ductile, or elastic. Nature presents none which under compression does not suffer a portion of caloric to escape. Thus a body is never perfectly elastic, because the quantity of caloric compressed, being less than the total quantity, cannot restore itself with the same force as if this fluid had remained in its entire state, and cannot keep the moleculeæ of the body separated at the same distance as before compression. Besides, the velocity with which it restores itself is also less than that which produced the compression, for a part of this velocity has been destroyed by the entire mass of the compressed body.

A body is more flexible according as it contains more caloric between its moleculeæ. This very compressible fluid permits concave molecule to approach each other without the convex molecule being obliged to separate from each other, as if there were not caloric interposed between them.

The preceding observations may serve to throw some light on various phenomena of elasticity. A blade of copper not hammered evidently remains in that state into which it is put by bending, because the moleculeæ of the concave part express, by approaching each other, that portion of caloric which adheres least to them. The other portion, which does not escape, is indeed compressed; but the excess of the spring is compensated by the excess of the adherence of the moleculeæ brought together: the body remains in that state in which it is placed.

If the blade has been hammered, it loses by that operation a portion of caloric; the other portion remains compressed; and, when this blade is bent, the compression of the fluid is increased. The excess of spring which it acquires is not counterbalanced by the excess of the adherence of the moleculeæ: it tends to restore itself; and the body passes to that state which is called *elastic*.

The compression and re-establishment of caloric may serve to explain also the oscillations of the moleculeæ of a tube of glass terminated by a ball of the same nature, when rubbed with a moistened sponge in order to obtain from it acute tones. The moleculeæ of the tube having, by the extension which it experiences, quitted the position proper for their equilibrium, tend to return to it; and as by the velocity acquired they go beyond the term from which they set out, the interposed caloric is compressed, it re-establishes itself with a force equal to the compression, and repels the two parts of the tube to the distance at which they were at first, which occasions an oscillatory motion until it has been destroyed by the resistance of the air.

We might, strictly speaking, explain, without the intervention of caloric, the elasticity of the string of a violin, or of a bell, put into vibration: but from what has been said, it seems to act the most conspicuous part.

Elasticity manifests itself with less energy in liquids than in solids, and yet the former contain more caloric. The reason is plain; it is because their moleculeæ, being exceedingly moveable, they can easily withdraw themselves from the compressing forces; but they are elastic, since they have the property of transmitting sounds, and of recoiling back on themselves.

It must have been remarked, that the accumulation of caloric diminishes the spring of solid or fluid bodies: in gaseous bodies, on the other hand, this elasticity is increased by the accumulation, because these bodies, being held in solution in the caloric, participate in its mechanical properties, and chiefly its elasticity.

To increase or produce elasticity in certain bodies, we must employ means proper for bringing together their moleculeæ, and keeping the caloric in a state of great compression. The harder, therefore, that a body is, provided it is not so in the extreme degree, the more it will be elastic. It becomes, indeed, less flexible; but this inconvenience may be remedied by rendering the body thin, since its moleculeæ will then be less displaced during flexion. There are two things, then, to be considered in elasticity; the rapidity of

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the displacement of the parts put in motion, and the extent of the displacement, which depend on flexibility.

Allaying and tempering favour the increase of elasticity; because, these operations, by bringing the moleculæ nearer to each other, compress the caloric, which tends afterwards to re-establish itself. All these facts have induced the author to conclude, that caloric has at least a great share in all the phenomena exhibited by elasticity.

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**XII. On the Efficacy of Yeast in the Cure of those Diseases known by the Name of Putrid \***.

A REMEDY, which contains much fixed air, has been lately started by the Rev. Mr. Cartwright, which merits the highest attention. Seventeen years ago, says this gentleman, I went to reside at Brampton, a very populous village near Chesterfield. I had not been there many months before a putrid fever broke out among us: finding by far the greater number of my new parishioners much too poor to afford themselves medical assistance, I undertook, by the help of such books on the subject of medicine as were in my possession, to prescribe for them. I early attended a boy about fourteen years of age, who was attacked by this fever; he had not been ill many days before the symptoms were unequivocally putrid. I then administered bark, wine, and such other remedies as my book directed. My exertions, however, were of no avail; his disorder grew every day more untractable and malignant, so that I was in hourly expectation of his dissolution. Being under the absolute necessity of taking a journey, before I set off I went to see him, as I thought, for the last time, and I prepared his parents for the event of his death, which I considered as inevitable, and reconciled them in the best manner I was able to a loss which I knew they would feel severely. While I was in conversation on this distressing subject with his mo-

\* The contents of this article cannot be too generally known. How many valuable lives are yearly lost by putrid sore throats, fevers, &c. which might be saved to the community, and to their relatives, if the cure here recommended were generally known and resorted to! with proper medical aid, however, where it can be had. EDIT.

ther,

ther, I observed in a corner of the room a small tub of wort working ; the sight brought to my recollection an experiment I had somewhere met with, of a piece of putrid meat being made sweet by being suspended over a tub of wort in the act of fermentation. The idea instantly flashed into my mind, that the yeast might correct the putrid nature of this disease, and I instantly gave him two large spoonfuls. I then told the mother, if she found her son better, to repeat this dose every three hours. I then set out on my journey : upon my return, after a few days, I anxiously inquired about the boy, and was informed he was recovered. I could not repress my curiosity : though I was greatly fatigued with my journey, and night was come on, I went directly to where he lived, which was three miles off, in a wild part of the moors ; the boy himself opened the door, looked surprisingly well, and told me he felt better from the instant he took the yeast.

After I left Brampton, I lived in Leicestershire : my parishioners being then few and opulent, I dropped my medical character entirely, and would not even prescribe for any of my own family. One of my domestics falling ill, accordingly the apothecary was sent for ; his complaint was a violent fever, which in its progress became putrid : having great reliance, and deservedly, on the apothecary's penetration and judgment, the man was left solely to his management. His disorder, however, kept daily gaining ground, till at length the apothecary considered him in very great danger ; at last, finding every effort to be of service to him baffled, he told me he considered it as a lost case, and that, in his opinion, the man could not survive four-and-twenty hours. On the apothecary thus giving him up, I determined to try the effects of yeast. I gave him two large table spoonfuls ; in fifteen minutes from taking the yeast, his pulse, though still feeble, began to get composed and full. He in thirty-two minutes from his taking the yeast was able to get up from his bed, and walk in his room. At the expiration of the second hour I gave him a basin of sago, with a good deal of lemon, wine, and ginger in it ; he eat it with an appetite : in another hour I repeated the yeast ; an hour afterwards I gave the bark as before ; at the next hour he had food ; next he

had another dose of yeast, and then went to bed; it was nine o'clock. I went to see him the next morning at six o'clock; he told me he had had a good night, and was recovered. I, however, repeated the medicine, and he was able to go about his business as usual.

About a year after this, as I was riding past a detached farm-house at the outskirts of the village, I observed a farmer's daughter standing at the door, apparently in great affliction; on inquiring into the cause of her distress, she told me her father was dying. I dismounted, and went into the house to see him. I found him in the last stage of a putrid fever; his tongue was black, his pulse was scarcely perceptible, and he lay stretched out, like a corpse, in a state of drowsy insensibility. I immediately procured some yeast, which I diluted with water, and poured it down his throat. I then left him, with little hopes of recovery. I returned to him in about two hours, and found him sensible, and able to converse. I then gave him a dose of bark; he afterwards took, at a proper interval, some refreshment: I staid with him till he repeated the yeast, and then left him, with directions how to proceed. I called upon him the next morning at nine o'clock, and found him apparently well walking in his garden: he was an old man, upwards of seventy.

I have since administered the yeast to above fifty persons labouring under putrid fevers, and, what is singular, continues this benevolent clergyman, "I have lost not one patient."

Dr. Thornton, whose opportunities have been great in putrid fevers, having the superintendance of a dispensary\* which includes the poor of nine parishes, and is situated in the vicinity of St. Giles's, has made frequent trials of yeast, and speaks highly in its praise.

One day, says the Rev. Mr. Townsend, by accident, as Dr. Thornton went past a shop † in Tottenham-Court Road, he heard the screams of a mother who was agonised on seeing her child, as she thought, expire. These screams renewed the struggles of the child, and the nurse who attended threatened to take away at this moment the child, that it

\* The General Dispensary;

† Mr. Burford's,

might

might die in quiet. Dr. Thornton got down immediately some tartar emetic, which quickly acted as a vomit; and after the operation was over he gave rhubarb, which cleared the intestines; he then ordered the child, every two hours, yeast and water, with wine and bark, and in three days the dying child was up and well.

The infection had spread to two others in the same house; in this child, and in another, the putrid fever was attended with swelled glands, which suppurred, and threatened gangrene: in a robust servant girl it took the form of a dreadful putrid sore throat; she had an emetic, and afterwards some rhubarb, then yeast and water every two hours. The first effects of this newly discovered remedy was that of rendering the pulse fuller and fifteen beats less in a minute, and her black tongue soon assumed a clean and red appearance: without bark or wine she was speedily recovered.

In Dr. Beddoes' Considerations there are the following cures:—Mr. Caldwell, engraver, (as Dr. Thornton reports,) requested him to go into Green-street, Leicester-Fields, to attend Mr. Hadril, who, he said, it was supposed would not outlive the day. I found him labouring under a dreadful putrid sore throat, the tongue was black and thick coated, and the pulse quick and fluttering; evacuations being first premised, yeast and bark in porter were exhibited every two hours: his sister, who nursed him, was soon after attacked by the same fever, but the throat was not affected. She was not like her brother confined to her bed, but her weakness was so great that she could not walk across the room, nor even stand up half a minute without support. In both these cases the relief from the yeast was very striking, and they were soon cured: the wife was also infected, who received a similar benefit from the yeast.

The most extraordinary cases, however, are the following:—In Husband-street, a small confined situation near Berwick-street, a fever broke out, which in the short space of a fortnight, in three houses only, swept away six persons. Dr. Thornton's assistance was at this time called in to Mrs. Wollot, No. 1, in that street, who lay delirious and comatose, with her two children, all in the same bed. She re-

fused medicine and food, and was obliged to be drenched in order to get either down : an emetic and cathartic being premised, they were all put upon the same plan ; that is, were to take, every three hours, two-thirds of a glass of fresh porter, with two table spoonfuls of yeast and the juice of half a lemon ; and the food at intervals was the white of eggs, which Dr. Thornton judged of all things were least subject to putrify\*, beat up with some sugar and water, and, as it was the commencement of summer, strawberries were also ordered ; and without any farther medicine from the apothecary than the emetic and purge, although the woman was at first obliged to be drenched, yet she and her whole family recovered, and this very rapidly.

Among the poor in St. Giles's nothing is administered by Dr. Thornton, after cleansing the primæ viæ, than two table spoonfuls of yeast in some porter every two hours ; and out of above forty cases not one has died under this treatment.

XIII. *On the various Effects produced by the Nature, Compression, and Velocity of the Air used in the Blast-Furnace.*  
By MR. DAVID MUSHET, of the Clyde Iron-Works.  
Communicated by the Author.

WHEN it is considered that in the smelting operation the reduction of immense quantities of materials is effected by a compressed current of air impelled by the whole power of a blowing machine, the consequences of the change of air, either in quantity or quality, must be very obvious : when, farther, we contemplate the metal called into existence by means of combustion thus excited ; when we consider iron as having the most powerful affinity for the base of that part of the air which maintains combustion ; and when we view the debased state to which the metal is reduced by coming into improper contact with it, we must conclude, that the application of blast in the manufacturing of iron calls for the

\* We know that eggs are kept for a great length of time, and the white, even under the heat of the hen's body, does not putrify, and it serves as milk to the embryo in the egg.

most minute and thorough investigation. In order to take a comprehensive view of this subject, the following division will be requisite:—

1st, The intimate connection which the quantity of blast bears to the area of the internal cavity of the furnace, and to the nature of the pit-coal.

2d, The various modes by which air is procured, and how these respectively affect the quality of the air.

3d, The various changes to which air is subjected by a change of temperature in the atmosphere, with the consequent effects.

4th, How far increased or diminished velocity and compression alter the results of the furnace.

5th, The form and diameter of the discharging-pipe.

1st, Then, in the construction of a blast-furnace and blowing-machine, the quantity of air to be used ought to depend upon the internal dimensions of the former; which, again, ought to be formed according to the quality of the pit-coal. Upon the softness or hardness of the coal, ought more immediately to depend the height of the blast-furnace. This necessary precaution has given rise to a vast variety of furnaces, of different capacities, from 30 to 50 feet in height, and from 9 to 16 feet diameter at the bothes. Furnaces from 30 to 36 feet are used for the softer qualities of coal, such as a mixture of free-coal and splint. Furnaces from 36 to 45 are appropriated to the burning of splint-coal cokes; and in Wales, such is the superior strength and quality of the pit-coal, that the furnaces admit of being reared to the height of 50 feet.

These various qualities of coal, it has been formerly shewn; have appropriate weights of iron-stone, and, to use the language of the manufactory, are capable “of supporting a greater or lesser burden of mine.” The former qualities admit not of having the air discharged in great quantity, unless it is impelled under an uncommon degree of compression and consequent velocity incompatible with the operations of a steam-engine. The reason is obvious: when air, loosely compressed, or comparatively so, is thrown into a body of ignited fuel, the mechanical structure and continuity of whose particles

particles are soft, the air is much more easily decomposed; the ignition, of course, is more rapid: the descent of the materials is promoted beyond their proper ratio, and long before the carbonaceous matter has penetrated the ore, or united to the metal, to constitute fusibility. I shall adduce an example, as being most illustrative of this doctrine.

Suppose a blast-furnace, 35 feet high, 11 feet wide at the bothes, properly burdened, and producing No. 1, pig-iron. Let the discharge of air be supposed equal to a pressure  $2\frac{1}{2}$  pounds upon the square inch, or equivalent to 1-6th of the atmosphere, or 5 inches of mercury: under these circumstances let it farther be supposed, that 1500 cubical feet of air are discharged in one minute; and that the diameter of the discharging-pipe is 2.625, the area of which is equal to 6.89625 circular inches. Let the discharging-pipe be increased to 3 inches diameter, and let the same quantity of air be passed into the furnace; it is evident that as the area of the discharging-pipe is increased to 9 circular inches, or nearly 1-3d more than formerly, the compression of air must be proportionally diminished. This alteration is soon perceived by its effects; the quantity of scoria increases from the furnace, whilst the consumption of the materials above is also considerably augmented. In a few hours the scoria will have undergone a complete change, from pure white, enamelled with various blue shades, to a green, brown, or black colour, considerably charged with the oxyd of iron \*. The same effects will continue, in greater or lesser degree, till all the materials are reduced which were existing in the furnace at the period of diminished compression. The philosophy of this fact may be accounted for in the following manner:—

While the just association of proportions remained, the air was discharged under such a degree of compression as to excite proper combustion: the decomposition of the air by means of the ignited fuel, was not effected in immediate contact with the separating metal, but had, by its uncommon degree of density, resisted decomposition in the ignited pas-

\* The metal will have lost nearly all its carbon, and have become inferior in value 25 to 30 per cent.

age, and had been decomposed upon the cokes at a greater elevation in the furnace. As a proof of this, we frequently see a tube formed throughout the whole breadth of the furnace, quite black and apparently cold, formed of the fused materials: when this is removed, a considerable descent momently takes place of cokes heated visibly beyond the common pitch: these inflame rapidly, but are soon again cooled to blackness by the incessant discharge of air upon them. The descending mixture of iron and lava are in like manner cooled around the line of blast; the tube is again formed, and, if not removed, will remain for days together, while the furnace will be otherways working in the best manner.

When by accident or design the compression and velocity of the blast are diminished, the tube begins to burn, and throws off a great many red fiery-coloured sparks, the sides and roof fail, and are carried before the blast in all directions. Sometimes considerable cloots of imperfect iron are recoiled with such violence as to escape the vortex of blast, and issue from the tuyre-hole with such velocity as to inflame in the air, and fall down in the state of oxyd. In the end the tuyre will appear to flame, and all the passage inwards shews an astonishing degree of whiteness. The decomposition of the air is instantaneously effected upon its entering the ignited passage; the iron by this means is exposed to the oxygen that is disengaged; and the vast quantity of caloric set free, in consequence of its union with the iron and carbon, produces the astonishing heat now visible, but which formerly took place at a more proper height in the furnace.

From this it will appear, that although a greater apparent degree of heat is visibly produced by the sudden decomposition of the air, and a more rapid descent of materials for some time is the consequence, yet, as the quality of the iron is impaired, and as in the end the furnace will return to its old consumption of materials as to quantity, the effects of a loose soft blast are conclusively pernicious.

It sometimes happens, that when a loose blast is surcharged with a considerable portion of moisture, or comes in contact with cokes which had been wet when introduced into the furnace, the inflammation which takes place at the tuyre is prodigious;

prodigious: fine fire-clay will be melted down and blown to slag in a few minutes; the sides of the furnace, composed of very infusible fire-stone, is next attacked, and in a few hours will be so completely destroyed as to stop the working, and require immediate repair. Effects similar to those now described will be felt when blast is improperly proportioned to coal of a stronger continuity of fracture and superior quality. Besides the effects produced by the sudden decomposition of iron, others of like nature are produced where a soft coal is used, a small furnace, and a great discharge of blast.

It has been found that crude iron, to be properly matured, ought to remain in the blast-furnace, according to circumstances, 48 to 60 hours; that is, from the period that the iron-stone is introduced till such time as the metal begins to occupy its place in the hearth in a state of perfect separation. When the contrary is the case, the mixtures arrive at the hottest parts of the furnace before the metal has taken up a sufficient quantity of carbon from the fuel; the action of the blast, and the immediate heat by which the ore is surrounded, forces the iron from its connections to the bottom of the furnace. The quality is de-carbonated, and reduced in its value: to restore this again, the local portion of fuel is increased; this adds to the expence of manufacturing, and diminishes, in some measure, the smelting of the furnace.

When splint-coal cokes are used in the blast-furnace, the blast admits of being thrown in under the highest possible pitch of compression; the uncommon density of the charcoal sustains a very powerful discharge of blast before it is dissipated to facilitate the general descent. Most frequently, large masses of these cinders pass through the whole ignited cavity, and are thrown out below, possessing all the acuteness of their original form and fracture.

This quality of coal is used in all the Curson blast-furnaces, where, to ensure a respectable produce, the air is discharged under a pressure equal to  $3\frac{1}{4}$  pounds upon the square inch, or  $6\frac{1}{2}$  inches of mercury.

The same quality of coal was used at the Devon iron-works, where, at one time, having all the blast of a 48 inch cylinder engine thrown into one furnace, the column of

mercury supported was upwards of 7 inches ; the quantity of air discharged under such an impelling power, I found to exceed 2600 cubical feet *per minute*.

The coals used at the Cleugh, Cleland, and Clyde iron-works, are nearly of the same quality at each—a mixture of splint and soft coal. The Muirkirk and Glenbuck iron-works have a coal different from any of the former, and in some particular spots it considerably resembles the English clod-coal.

2d, The various methods of procuring air for the blast-furnace may be reduced to the following :—1st, That procured by cylinders, and discharged into the furnace by means of a floating piston heavily loaded, and working in a large receiver or regulating cylinder : 2d, That wherein pumping cylinders only are used, and the air thrown into chests inverted in water, called the *water-vault* : 3d, That mode wherein the air is discharged from the pumping or forcing cylinder into an air-tight house, called the *air-vault*.

The first method is the original mode of blowing, and is still much used at those iron-works whose erection has been prior to the last fifteen years. By this mode the quality of the air is less subject to alteration by a change of atmosphere. The principal objection to this manner of blowing, is the want of capacity in the receiving cylinder; which cannot be increased so much as to take away the considerable intervals which occur at different parts of the engine-stroke. This effect is sensibly seen by the speedy and irregular ascent and descent of the column of mercury. In water blowing-machines, where the air is raised by three or four cylinders worked by means of a crank, where the air is received into an air-chest, and forced into the furnace by the continual action of the blast of each successive cylinder, the current of air is steady, and supports the column of mercury with great uniformity.

The use of the water-vault has of late years become very general among new erected works. Its properties are, a steady and very cold blast : the largeness of the receiving cisterns gives them a sufficient capacity to retain every pound of air

raised by the furnace, and distribute it to the greatest advantage. This is not the case with the floating pistons, where a certain quantity of spare wind is thrown out at every return of the engine, lest the great piston and weight should be blown out of the cylinder altogether; which, indeed, sometimes happens. The only objection which remains in force against the use of the water-vault, is the tendency which it has to take up a considerable portion of the water in solution, and introducing it into the furnace. A judicious arrangement of the conducting-pipes would in some measure obviate this, as well as the more dangerous tendency which water has to rise in a pipe speedily emptied of its air by the stopping of the engine: a stream of water thus conveyed to the furnace, would be productive of the most awful consequences.

The air afforded by the air-vault is much inferior to that obtained in the former methods. This immense magazine of compressed air generates a considerable portion of heat, which greedily seizes the damps, which are unavoidable in underground excavations, and conveys them to the furnace. The blast is, however, steady and uniform; and when the inside of the building is completely secured against the passage of air, it is productive of considerable effects in the furnace. In the summer months, however, the air becomes so far debased as to affect the quality of the iron, and change it from grey to white. Every change in the temperature of the atmosphere during this period, is indicated by various changes in the furnace.

The largest air-vault hitherto in use was excavated out of solid rock at the Devon iron-works: the fissures of the rock admitted considerable quantities of water; and the same degree of damp would always prevent the possibility of making the side-walls and roof air-tight by means of pitch and paper, &c.

Besides the various natures of blast, as to the strength and equality of the current afforded by different modes of constructing the blowing-machines, a variety in the quality of the air obtained is also an invariable consequence: this is sufficiently

sufficiently known by the effects which it produces in the blast-furnace, and ought to be subject to scrupulous examination.

In this, as in other countries, larger produce of cast iron are obtained in the winter months than during the summer and autumn seasons: the quality of the metal is also much more carbonated, and with a less proportion of fuel. In many parts of Sweden, where the summer heats are intense, the manufacturer is obliged to blow out or stop his furnace for two or three months: not only is he unable to make carbonated metal, but is frequently incapable of keeping the furnace in such trim as to make a produce of any quality whatever. In Britain, during the months of June, July, and August, more especially in dry seasons, the quality of the iron, with the local proportion of fuel, will be depreciated 30 *per cent.*, and the quantity reduced to 2-3ds or 3-4ths.

In seeking for a solution of this universally acknowledged fact, our attention is naturally directed to an examination of the various states of air. That the quality of the air in winter is more fit for combustion than in summer, is a truth which requires no farther demonstration. Greater coolness, whereby an almost complete refrigeration of moisture takes place, and the presence of perhaps a greater relative proportion of oxygen, may account for this phenomenon. On the contrary, the quality of air during the summer months becomes much contaminated for combustion, by holding in solution a much greater quantity of moisture: the abundance of nitrous particles may also diminish the usual proportion of oxygen.

This will account for the inferior effects of combustion both in common fires and in the blast-furnace; it will also in a great measure tend to solve the curious phenomenon of pig-iron taking up less carbon in summer, although reduced with a superior quantity of fuel. The air discharged most probably contains less oxygen; yet the metal is much less carbonated than at other times, when contrary proportions of these exist. Most probably the deficient carbon is carried off by dissolving in hydrogen, forming a constant stream of hydro-carbonic gas, while the oxygen that is set free unites to the iron; and while it reduces its quality, at the same time

the quantity is reduced by a portion of the metal being lost in the scoria\*.

To correct these occasional imperfections in the quality of the air, and to devise methods to procure air always fit for proper combustion, ought to be an object of much consideration to the manufacturer of cast iron. Whether such a consideration has given rise to the different modes of receiving and discharging the air now in use, I cannot say; I rather think not: a great quantity of air has hitherto been a greater object than a certain and uniform quality; and in a country where there is more temperate and cold weather than hot, it is by far the most important object: to unite both, however, would be an attainment of the greatest utility, and would rank the discoverer amongst the well-deserving of his country. How far the mechanism of our present machinery has been adapted to the exigencies of our atmosphere, will appear upon examining the nature and properties of the air, judged by its effects upon the blast-furnace.

The air produced by the blowing and receiving-cylinder is less changed, and less subject to change, than that produced and lodged in contact with a vast body of air or water. If the blowing-cylinder is fixed in a dry cool spot, the only difference which the air undergoes is an increase of temperature; this is so very considerable, that upon entering the blowing-cylinder immediately after stopping the engine, I have found the thermometer rise 15 to 17 $\frac{1}{2}$  degrees higher than the surrounding air. That this heat is generated in the cylinder is unquestionable; but whether it is occasioned by the friction of the piston leather upon the sides of the cylinder, or expressed from the air by its severe compression, I have not yet been able to decide. It very probably arises from both causes, although the latter is sufficient to produce a much greater degree of heat. What effect this increase of temperature has upon combustion we are unable to say, as the degree of heat accumulated will at all times bear a reference to the temperature of the surrounding air, and as

\* May not the superabundant azote of the summer atmosphere produce part of these effects, by dissolving a portion of the carbon, and forming carbonated azotic gas, as has been proved by M. Lavoisier?

There is no method likely to be devised where heat would not be generated by the action of the particles of air upon each other. When the bulb of a thermometer is held in the middle of the current of blast, as it issues from the discharging-pipe, a temperature is indicated as much lower than the temperature of the surrounding air, as the temperature of the cylinder was higher; and it is most probable that a much lower degree would be obtained, were it not for the previous expression of some heat in the blowing-cylinder. Upon the whole, I think, the quality of the air obtained in this way of blowing uniformly most fit for combustion, provided the numerous pauses and irregularities of the current of air were done away.

Air forced into the furnace under water pressure always contains a considerable portion of moisture; the blast of course is colder, as it issues from the discharging-pipe. The temperature differs so much from that of the external air as to sink the thermometer from  $54^{\circ}$  down to  $28^{\circ}$  and  $30^{\circ}$ . Such effects are produced by air coming into contact with water, that, although the temperature of the atmosphere is  $60$ ,  $65$ , to  $70$ , yet the blast at the orifice seldom rises above  $38$ : the cold produced in this manner is much increased if the air is surcharged with so much water as to be visible in the state of a fine spray. The leading feature, therefore, of the water-vault, as to its effects upon the quality of the air, seems to indicate an almost uniform degree of temperature in the blast: this can only be occasioned by the warm air in summer taking up a greater portion of the water in solution, the escape of which at a small orifice, and under a great degree of compression, produces the very great depression of the thermometer. I have already hinted at the bad effects produced by moist blasts, and shall, in a proper place, more minutely attend to them.

The most inferior quality of air used in the blast-furnace is that thrown into the air-vault, and afterwards expressed from thence by its own elasticity and the successive strokes of the engine. The capacity of such a building is from  $60$  to  $70,000$  cubical feet; this, when filled, generates a much superior degree of heat to that sensible in the blowing-cylinder.

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As this heat is produced many feet distant from any mechanical motion, it is most evident that it is extricated from the air, and will readily unite with the moisture which penetrates the building: the quality of the air introduced into the furnace will therefore be in proportion to the quantity of moisture taken up; this will be much more in summer than in winter, as the temperature of the former exceeds that of the latter. The sensation, on entering the air-vault in the coldest months, immediately after stopping the engine, is exactly similar to that experienced upon entering a crowded room in the hottest summer day; the walls are covered with damp, and the superior regions of the vault readily obscure the flame of a candle. The feeling, upon remaining in the air-vault when the engine is at work, is less marked than would be expected where so great a compression of air existed; the sense of hearing, owing to the moisture in the conducting medium, is considerably impaired, and respiration is performed with some difficulty; the light of a candle is faint, and not visible at the distance of a few feet.

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XIV. *Some Remarks on the Scotch Distillery, and a Description of an improved Still, which may be charged and run off Seventy-two Times in Twenty-four Hours* \*.

**T**H E improvements that have taken place in the common distillery business in Scotland within these few years are such as cannot fail to excite the wonder of men of science, while they serve to prove, at the same time, that, to insure progressive improvement in any branch, the most effectual mean is that stimulus which results from interest.

It is not necessary, and it would be tedious, to describe the progress of the distillery in Scotland, since it first began to assume a form of some consequence, about twenty years ago. It may, however, not be thought improper to mention what gave occasion to the licence act being introduced into

\* Extracted from the Report of the Committee of the House of Commons, July 1799.

the Lowlands of Scotland, by which the manufacture and duties levied on spirits in Scotland and in England became regulated by distinct and separate laws.

The Scotch distillers, previous to the year 1786, had sent large quantities of spirits to the London market, which had occasioned a reduction of the price; and it was found also that the revenue of the distillery had diminished. From this circumstance it was suspected that frauds were committed against the revenue to a great extent; and the London distillers having received certain information of the manner in which the duties were evaded in Scotland, this suggested the necessity of making separate and distinct laws for raising the duties in the different kingdoms.

Therefore, in July 1786 the licence act for the Lowlands of Scotland commenced, and was to continue for two years. The principle on which this act was framed, between the contending and rival distillers of the two kingdoms, with consent of the minister, was in this manner:—

The duty then paid by the English distillers was sixpence *per gallon* on the wash; and supposing that 18 gallons of spirits, 1 to 10 over hydrometer proof, were taken from 100 gallons of wash, the duty on the spirits of that strength amounted to 2*s. 9 $\frac{1}{2}$ d.* *per gallon*. The distillers in the Lowlands of Scotland were allowed to work stills of any capacity or extent, on paying an annual licence duty of thirty shillings *per gallon* on the content of their stills; and the spirits thus made were to be consumed in Scotland. They were also allowed to send their spirits into England on paying an additional duty of two shillings *per gallon*, of the strength of 1 to 10 over hydrometer proof, when landed there. Thus it was computed, that the annual licence duty of the Scotch distillers would be equivalent to the remaining 9 $\frac{1}{2}$ d. *per gallon* paid by the English distillers, on this ground, that the Scotch distillers could run off their stills only *once* in the 24 hours.

The licence act being settled in this manner, and as the English distillers considered they had been thus far successful in fixing the Scotch to pay a certain duty of 2*s. per gallon*, not to be evaded, they expected to have had the London

market

market to themselves: but they soon found they were mistaken, and that the Scotch continued to send increased quantities, and the price of spirits fell very low in the London market.

In the beginning of 1788 an investigation took place in a Committee of the House of Commons, respecting the number of times in which the Scotch distillers had worked off their stills in a given time, and it was found that they were in the practice of running off their stills five or six times in the space of 24 hours. It was therefore inferred, that by misrepresentation they had obtained an undue advantage over the English distillers; and in February 1788, before the two years of the licence act had expired, an additional duty of sixpence *per gallon* was laid on all spirits sent from Scotland to England; the remaining  $3\frac{1}{2}d.$  *per gallon* being reckoned a sufficient equivalent for the licence duty. It must well be remembered, that at this time the Scotch distillers, who had long contended with the English, became bankrupts, and resigned that market to their rivals. Since that time new regulations have been made, by which the whole of the English duty is paid on the Scotch spirits when landed in England; and the revenue arising from the distillery has very much increased.

Having endeavoured briefly to mention the causes which originally occasioned the licence act to be introduced into the Lowlands of Scotland, it may now be proper to observe, that the ingenuity of the distillers, working by the licence act, has constantly been excited, and always successful in lessening the duties, their success having kept pace almost in the degree in which the duties have been increased. For, when the licence act commenced in 1786, the distillers continued for some time to use stills of a large size, and the duty being only  $30s.$  *per gallon* on the content of the stills, they did then work them off five or six times in the 24 hours; by which the duty cost from  $2d.$  to  $3d.$  *per gallon* on the spirits. In 1788 the duty was increased to  $3\frac{1}{2}d.$ , and it continued at that rate for about five years: during this space they improved in running off their stills to about 20 times in the 24 hours. They attained to this degree of dispatch by greatly reducing the size of their stills, and enlarging their furnaces.

At this time the duty on the spirits did not cost them above one penny *per gallon*, which being very small they did not think any farther improvement necessary.

Since the commencement of the present war, the minister has thought that to lay an additional duty on spirits made in Scotland would be a proper measure; and in 1793 the annual licence duty on the stills was increased to 9*l.*, and in 1797 to 54*l.* *per gallon*, which is the present duty. He had reason to expect that a large increase of revenue would arise from this high duty; and yet it must appear very surprising that the revenue from the Scotch distillery has not increased in any considerable degree. This is not owing to a diminution in the consumption of spirits; for, the price of that article being so low in December last as 3*s.* *per gallon*, there can be no just reason to think that a less quantity has been used.

When the distillers found the duty raised on them so high as 54*l.* *per gallon*, they tried every expedient in order to accelerate the process. From repeated experiments they have found, that the more shallow the stills are made, and the bottoms enlarged, the more they can increase the size of the furnace, and apply a larger quantity of fuel, and consequently bring the wash in the still to boil in a shorter space of time. The liquor in the still being likewise on a more extended surface, the evaporation or process of distillation is performed in a more expeditious manner. It is principally by the shallowness of the stills that the Lowland distillers are now enabled to run off their stills three times in the hour, or seventy-two times in the 24 hours; a degree of dispatch which a few years ago was thought to have been impracticable.

Plate III. is a representation of one of the common flat stills\* now used by the Scotch distillers. A represents the ash-pit; b, the grate; c, the furnace-door; d, the flame passing on towards the flue; and e, the body of the still; f, the bottom and side-scraper, an apparatus which is made to revolve continually during the process by means of an upright shaft g, driven by machinery, and which passes through a cup-mouthed aperture h. This is made steam-tight by means

\* Other improvements have been introduced, of which we shall give some account in a future Number.

of wool and grease, held down by a plate of metal fastened by screws. *i* is a plate of copper, concave, or rather conical below, stretching almost to the side of the still; *m* a large hole in the centre of this plate, through which the steam generated at the bottom of the still escapes into the head. This plate, being made of quick ascent, facilitates the escape of the steam, which might otherwise be partially accumulated under the shoulder of the still, and, by its re-action on the subcumbent liquor, cause the still to run foul, or boil over. *kk* the head of the still. To the scraping-machine *f* are attached chains, which, by the rotary motion of the scraper, are dragged with rapidity over the whole of the bottom, by which means the wash is prevented from burning to the bottom, and thereby generating any new compound injurious to the flavour or quality of the spirit. These stills are usually of from 40 to 50 gallons contents.

The principle of the improvement seems to centre in this simple point—The greater the quantity of heat that can be made to pass through the body of the still in a given time, the greater will be the quantity of vapour, and consequently of spirits, produced in that time: and certainly it is not easy to conceive how this can be attained in any way so effectually as by making the still *all bottom*, as it were, and applying the heat to every part of that bottom.

XV. *Observations on Spiders, and their supposed Poison.*  
By M. AMOREUX jun. M.D.\*

**T**HIS genus of insects is as numerous in species as the latter are varied. France contains almost the half of the species known. M. Geoffroy has mentioned only sixteen; but Dr. Lister, who made observations of the same kind in England, and M. Clerk, who carried them as far as any one in Sweden, have given a more complete history of them. Scopoli, so commendable in other respects for his useful labours, does not appear to have done right in changing entirely the denomination of forty-four species of spiders, which he saw

\* From *Notice des Insectes de la France réputés venimeux.*

in Carniola, merely that he might have the pleasure of giving to each the name of some illustrious person who has promoted the science of entomology. This mark of honour is of little consequence to such great Mecenases, and the inconvenience of increasing and confusing the received nomenclature is very great.

The public care little also for the exact descriptions of naturalists, and their methodic classifications. They require facts; something wonderful and extraordinary. They wish that every natural being should present some new phenomenon; an object of immediate utility, or a subject of reprobation: and when their prejudices are once established, nothing can destroy them. Sometimes, for the truth must be confessed, naturalists in their writings have been the source of errors and prejudices. Were we to correct the assertions of Pliny, Johnston, Mouffet, and Aldrovandi, authors still quoted, and which one cannot read with patience, respecting insects only, we should make a large book of controversies, which would serve neither to instruct the learned, nor to undeceive the people, always wedded to their ignorance.

The history of spiders, and that of the effects of their venom, were it properly treated, would alone furnish matter for an ample chapter. What variety in the sensations of man! Some have an invincible aversion to spiders; and there are women who faint at the bare mention of their name\*: others treat them with familiarity, and think it an

act

\* This antipathy is no less strong, though often more reasonable, among the men. M. Zimmerman relates the following singular instance of it, to which he was a witness:—"Being one day in an English company," says he, "consisting of persons of distinction, the conversation happened to fall upon antipathies. The greater part of the company denied the reality of them, and treated them as old women's tales; but I told them that antipathy was a real disease. Mr. William Matthew, son of the governor of Barbadoes, was of my opinion; and, as he added that he had himself an extreme antipathy to spiders, he was laughed at by the whole company. I shewed them, however, that this was a real impression in his mind, resulting from a mechanical effect. Mr. John Murray, afterwards Duke of Athol, took it into his head to make, in Mr. Matthew's presence, a spider of black wax, to try whether this antipathy would appear merely on a sight of the insect. He went out of the room, therefore, and returned with

act of prowess to eat them. So many things have been related for and against the assertion of spiders being venomous, that we cannot but be cautious in regard to what has been said on the subject by different authors; we must therefore request those who relate such stories in future, to give a correct description of the kind of spider or other insect which they believe to be poisonous, together with their common and scientific names, which will remove all doubt and confusion.

Our spiders in France are in general rather ugly than formidable. If there are any suspected of being poisonous, it ought not to be the domestic spider with long claws, *aranea parientina* and *aranea phalangiodes* Linn. nor the mower of the fields, *phalangium opilio* Linn. the only kinds of the phalangia mentioned by Geoffroy; nor the mason spider, with which perhaps this author was unacquainted, because it inhabits the southern provinces; nor the orange-coloured spider, and that entirely white *aranea viatica*, and the *aranea citrina* Linn. found commonly among vegetables and fruit, and chiefly grapes; nor so many others which we see daily, a bit of black wax in his hand, which he kept shut. Mr. Matthew, who in other respects was a sedate and amiable man, imagining that his friend really held a spider, immediately drew his sword in a great fury, retired with precipitation to the wall, leaned against it as if to run him through, and sent forth horrible cries. All the muscles of his face were swelled, his eye-balls rolled in their sockets, and his whole body was as stiff as a post. We immediately ran to him in great alarm, and took his sword from him, assuring him at the same time that Mr. Murray had nothing in his hand but a little wax, and that he might himself see it on the table, where it was placed.

He remained some time in this spasmodic state, and I was really afraid of the consequences. He however gradually recovered, and deplored the dreadful passion into which he had been thrown, and from which he still suffered. His pulse was exceedingly quick and full, and his whole body was covered with a cold sweat. After taking a sedative he was restored to his former tranquillity, and his fear was attended with no other bad consequences. We must not be surprised at this antipathy: the largest and most hideous spider are found in Barbadoes, and Mr. Matthew was born in that island. Some one of the company having formed of the same wax, in his presence, a small spider, he looked at it while making with the utmost tranquillity, but it would have been impossible to induce him to touch it. He was not, however, of a timid disposition."

and

and of which we have no cause to complain. If all our spiders were noxious, how many accidents would daily happen in houses which are not kept clean, and to those people who labour in the fields? In that case it would be highly proper to destroy them.

The brown, black, and hairy spiders, which reside in vaults and cellars, as they inspire the contagious air of dirty and uninhabited places, may have juices capable of doing hurt when they are bruised by accident on any naked part of the body, or introduced into the stomach. Of this, however, we have no well-attested proofs, though we know that the hairy spider is mischievous, and that it attacks even wasps, the scales of which it breaks with its strong forceps. But what shall we think of the popular opinion, that spiders lose their venom in certain privileged places? This is related of the old tower of Pariset at a league from Grenoble, situated on a mountain, and called by the populace *Tour Saint Verain*, to express the tower without poison \*; where, as is said, no serpent, spider, or venomous animal is to be found: we are even assured, that those carried thither immediately die.

Spiders have often attracted the attention of the curious by their manœuvres, their amours, and singular mode of copulation; as well as by their address in spinning their webs, and forming cods, in which they inclose their eggs; on account of their art in repairing the accidents which happen to their webs, and the breaches they make in them on purpose to deliver themselves from too strong a captive they have entangled; and of their perpetual wars, and the carnage they occasion, &c. These are the actions not of mere au-

\* John Tardif, a physician, who wrote in 1618, speaks very seriously of the tower without venom, as one of the wonders of Dauphiny. M. Lancelot, who reduced all the wonders of this province to their just value in a memoir upon this subject inserted among those of the Academy of Inscriptions and Belles Lettres, Vol. VI. says, that the tower without venom is no longer worthy of that name. It is false that no venomous animals live near it; serpents and spiders are found there, as well as in other places. "I have seen some carried thither," says M. Lancelot, "for the sake of experiment, and it did not appear that they found themselves incommoded by the change."

*tomata*, and which must astonish those who view them with the eye of a philosopher.

A worthy magistrate, M. Bon, who was fond of natural history, at a time when it was necessary to surmount many prejudices, found means to breed spiders, and to extract silk from their cods, which he opened. All spiders are not weavers, but they are spinners, and all live by hunting. This hunting, for the most part, is only stationary, like that by decoy. These hunters display considerable cunning and address to make their prey fall into the snares which they have laid. One kind, the *aranea domestica*, extends its net horizontally in a corner, hooks itself to it, and in that manner lies in wait for its prey; another, the *aranea dumetorum*, places its net in a vertical position across an alley in a garden, to intercept the passing insects; one conceals itself in its cavern, and darts forth on the smallest noise; and another suspends itself from the branch of a tree by a long thread, and acts the tumbler, to attract stupid spectators. There are some which cover their cave on the outside with a kind of white silk, as if to announce, by a beautiful entrance, that there will be no danger to proceed farther: this is merely a decoy. Such is their occupation, their resources, and their industry. As in every numerous race there are vagabonds, some spiders employ themselves only in running about, and in jumping. Such are the habits of the wolf spider. There are some also exceedingly cruel, which employ their arms with great force and activity.

The structure of spiders is no less remarkable than their habits. They have always eight eyes, but differently disposed; and this has enabled naturalists to divide them into different classes, in order that they may be better distinguished. M. Fabricius, however, has made known five species with only six eyes. This is denied by M. Geoffroy, who apparently had not seen these species. But the most interesting organ in these insects is their mouth, since it is with this alone that they are able to hurt us. The mouth of the spider consists of two strong forceps, terminated by a kind of very sharp claws, the points of which are bent down.

downwards\*. These forceps or claws are moveable, and can easily be turned upwards or downwards, and even from right to left. It is with these instruments that the spider seizes, pinches, and kills its prey. The points also serve it as a mouth: though their extremity is very sharp, it is pierced towards the end; and the inside of the forceps is hollow; so that the spider by these means sucks up the moisture of flies, or of other insects which it seizes.

Swammerdam says, that what might be taken for teeth in the spider are real slings or darts with which it pierces those animals the blood of which it sucks: but this observer did not believe that the spider emitted from these darts a venomous liquor. Lister, who says he had certain proofs of spiders being venomous, expressed the poison from these instruments. Leuwenhoek also advances, that the venom of the spiders is contained in the cavity of the sharp pincers which proceed from the mouth of the insect. Others have said that these forceps are not hollow, but that the venom proceeds from a small trunk which issues from the mouth at the moment when the insect seizes its prey. It is possible, and even probable, that different kinds of spiders have a different organisation; and it is a certain fact, that many spiders, and perhaps all of them, throw out from their mouth a certain liquor, with which they moisten their prey. We may rest assured, however, that our spiders have nothing in them of a venomous nature; and this is proved by our so often touching them without danger. They are often between our teeth when we eat fruit and certain kinds of vegetables, yet we perceive no other bad consequences from them than those which may arise from fear and the idea of dirtiness. There are even spider-eaters, who make a sport of swallowing them: some do it through whim, others through a depraved taste, and some to shew their courage, or to gain a wager†. Redi

\* This description is according to Geoffroy, Vol. III. p. 631. Those of Linneus and Fabricius are as follows: *Aranæa. Os unguibus s. retinaculis dubis. Palpi duo articulati.* Linn. *Aranæa. Lubium breve, apice rotundatum. Palpi duo incurvi, maris clavati.* Fabric.

† Instances of spider-eaters may be found in the Ephemerides of the Searches into Nature, the Philosophical Transactions, and in Vander-wiel, who has collected a great many from different authors.

saw people who ate spiders, and, from the experiments which he made, he does not believe them to be poisonous. Dr. Fairfax is of the same opinion. Clerk and Roësel maintain, that spiders are not so venomous as is supposed, since many persons swallow them. It is related by the *Peintre Naturaliste*, that a man pretty far advanced in life ate all the spiders which he found, and that they served him as a purgative. He spread them on a slice of bread, as if they had been excellent marmalade. The same naturalist confutes the popular error, that the spider is able, by its pricking, to kill the toad. He saw nothing of the kind, though he made various experiments on that subject.

[To be concluded in the next Number.]

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XVI. *Some Account of the late MARK ELEAZAR BLOCH,  
of Berlin.*

**M**ARK ELEAZAR BLOCH, a Jewish physician established at Berlin, and well known by his Natural History of Fishes, was born at Anspach, in Franconia, of very poor parents. His father, who was exceedingly devout, spent his whole time in reading the Bible and the Talmud; while his mother, by selling old clothes, and other things of the like kind, gained enough to maintain her husband and children. M. Bloch, at the age of nineteen, could not read German, and did not know a single word of Latin. He had read only a few Rabbinical books, and spoke a kind of Franconian gibberish mixed with the Judaic jargon. A Jewish surgeon, settled at Hamburgh, having taken him into his house to instruct his children, he learned good German by hearing the gazettes read, and afterwards by studying the language. He lived so economically that he saved from his scanty salary as much as enabled him to pay for instruction in the Latin, which he was taught by a student as poor as himself. He acquired, at the same time, some knowledge of surgery; and, as he had relations at Berlin, he repaired to that city to study anatomy. Having surmounted various difficulties, and got himself admitted as Doctor in the University of Francfort,

he returned to Berlin and made himself known to M. Martini, by whose means he was elected a member of the Society of the Friends of Nature.

M. Bloch, in order that he might promote the objects of that institution, undertook a natural history of the Muræna, a fish caught only in the lakes of Pomerania. He began to form a cabinet of natural history; and having made a considerable collection of aquatic animals from all parts of the globe, he resolved to write a natural history of fishes. He caused drawings to be made and engravings to be executed from them with great correctness. By a fortunate accident he procured the original manuscripts of Father Plumier, at the sale of one of those Frenchmen who came to Brandenburg at the time when Frederic II. established the administration of excise. Father Plumier, of the order of the Minims, had made three voyages to America, and always brought back many interesting objects. Though he published nothing but on botany, if we except the art of turning, it is well known that he wrote a great deal on birds and fishes; but no one could tell what had become of these manuscripts: and it is still unknown in what manner they came into the hands of the above Frenchman, from whom they passed into those of M. Bloch.

This naturalist first published, in German, four numbers of an Economical Natural History of Fishes, particularly those in the States of Prussia, with figures from original drawings: Berlin, 1781 and 1782; large quarto. In the following years he gave an Economical Natural History of the Fishes of Germany, in three volumes, consisting of 108 plates, and in which the three numbers above mentioned were inserted. He published afterwards, in nine volumes, the Natural History of Foreign Fishes; so that his whole work, consisting of twelve volumes, contains 432 plates. The last appeared in 1795. He caused also to be made, at his own expence, by C. Laveaux, then at Berlin, a French translation of his work, which he published under the title of *Histoire générale et particulière des Poissons*, Berlin 1785—1788; six volumes folio, with 216 plates. It may be readily conceived that the expence of such a work must have been

considerable; unfortunately the number of the subscribers and purchasers was not sufficient to defray it. M. Bloch had the misfortune also to lose his only son, already distinguished by his talents, who died at Paris in 1787, when on a tour to France and England to procure subscribers to the French edition of his father's History of Fishes. This loss plunged M. Bloch, already oppressed with labour and expence, into the deepest affliction. He however still continued to employ himself on his History of Fishes, and, having concluded it, undertook a journey to Paris. This diligent naturalist, who has rendered great service to ichthyology, died at Carlsbad, in Bohemia, on the 6th of August 1799. Besides the above voluminous works, M. Bloch published a great many memoirs on Natural History in the Transactions of different Societies. His Dissertation on the Muræna, published in the Memoirs of the Friends of Nature at Berlin, has been mentioned already. In the same work he published also the following:—Observations on the regular Depressions in Vitriform Stones; on the Worms in the Intestines and Lungs of Birds; an Essay towards the Natural History of the Worms which live in other Animals; on Worms of the Bladder; Description of the Bustard and some kinds of Birds found in Marshes; on the Oil of Herrings; on the vulgar Opinion that the Organ of Generation in the Ray and Shark is double; on the *Myxina glutinosa* Linn. &c.

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### XVII. A Communication from Dr. LOANE, relative to Pneumatic Medicine.

#### A CASE OF ATONIC GOUT CURED BY VITAL AIR.

**A**UGUSTUS ERNEST, Esq. in the beginning of August 1799, was seized with symptoms of asthma, great wheezing, and difficulty of breathing, cough, mucous expectoration, and incapacity of lying in an horizontal posture. Hence arose much œdema of the lower extremities. Different medicines were tried without effect, when Lord Egremont urged him to make trial of the oxygen air, under Dr. Thornton, September 22. This remedy was had recourse to; and

and after inhaling the vital air but a few days, so much benefit was derived, that the patient was enabled to lie composed in bed during the whole of the night; and after a fortnight, so great was the energy produced, that the gout made its appearance in the great toe of the left leg. The asthma from this period quitted Mr. Ernest, and the inflammation continued for the space of ten days in the toe and parts adjacent; and the subsequent swelling gradually subsiding, the patient was restored to perfect health. He then went to Lord Egremont's, previous to which I received the following satisfactory letter:—

*Letter to Dr. Loane.*

November 9, 1799.

DEAR SIR, 10, Warwick-street, Golden-square, No. 7.

I am just going into Sussex to breathe there some of the pure atmospherical air; but I cannot leave this metropolis without reiterating to you and Dr. Thornton, with the tenderest feelings of gratitude, the warmest acknowledgments for the great benefit you have conferred on me by administering to me the vital air: indeed, when I compare the situation in which I was at the end of September, when I, as a dying man, came under both your care, to what, thank God, you have brought me now, it seems to me quite miraculous, and I shall always look with astonishment at the wonderful discovery which has been made so lately of the oxygen air.

I am, with sincere regard,

Ever faithfully yours,

AUGUSTUS ERNEST.

*Observation.*—When he returned to London, his friends, Lord Romney, Count Bruhl, &c. congratulated him on his recovery; but his asthma soon after made him a second visit, and the vital air was again resum'd, when in a few days it brought on another attack of the gout in both feet, which went off kindly, leaving the patient in excellent health and extraordinary spirits.

It may be proper to mention, the average dose of vital air daily given was six quarts, mixed with twelve of atmospheric air, and this was conjoined with the medicines most commonly exhibited upon such cases.

INTELLIGENCE,  
AND  
MISCELLANEOUS ARTICLES.

ROYAL SOCIETY OF LONDON.

**A**T the meeting, February 6, Dr. Young's paper on Sound was concluded. A paper by Mr. Cooper on the effects occasioned by the destruction of the membrana tympani, was begun.

On the 13th Mr. Cooper's paper was concluded. By this ingenious paper it appears the sense of hearing is very little impaired by the loss of the membrana tympani.

A very curious and interesting paper on the spontaneous emission of light by various bodies, by Dr. Hulm, was read on the 13th and 20th: it contains a number of experiments, some of which prove that light is a component part of all marine fishes; others, that putrid fish cease to be luminous, rotten wood to shine, and glow-worms to emit light, when surrounded by a frigorific mixture,

FRENCH NATIONAL INSTITUTE.

In the sitting of the French National Institute, Vendémiaire 15, year 8, October 7, 1799, C. Cuvier read the following account of the labours of the Mathematical and Physical Class during the last quarter of the year 7:—

The diamond, so valuable on account of its rarity and splendour, and so flattering to the vanity of man, had long ago attracted the attention of philosophers by other qualities. The ancients considered it as the most unalterable of bodies, and made it the emblem of the immutability of the decrees of Fate:—

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Si figit adamantino  
Summis verticibus dira' necessitas  
Clavos.

Mankind were much surprised when experiments proved what the genius of Newton had divined—that the hardest and

and most untractable of stones is converted into a little smoke and soot. But the question was, What is the nature of this combustible body? Is it a particular species, like sulphur, or phosphorus? or is it a compound of different combustible bodies, as oils and bitumens? There was only one way of answering these questions—to collect the product of its combustion. This has been done, and the product was found to be absolutely the same as that of the combustion of charcoal; that is to say, that deleterious vapour to which chemists have given the name of carbonic acid gas. Are the diamond and charcoal then the same thing? or, if not, in what do they differ? This is the problem which C. Guyton proposed, and which he has resolved. He first saw the diamond change itself into carbonic acid without leaving a residuum: if it differs then from charcoal, it is only because it contains something more. It produces much more of that acid, because it absorbs more oxygen during combustion than charcoal does; and if the combustion be suspended at a certain point, which C. Guyton did, by burning the diamond by means of the solar rays, you obtain real carbon. Thus common charcoal, making allowance for the earthy and saline matters which form the ashes, is not a simple substance, as hitherto believed. The diamond, by its first combination with oxygen, is converted into that substance of which the English make pencils, and which is called plumbago; by a second degree, into common black charcoal; and by complete saturation, into carbonic acid. The diamond, then, is really that ideal and simple being which chemists called carbon, and common charcoal is only carbon more oxygenated; that is to say, the two substances, which in their usual state appear to us the most transparent, form, by their union, the blackest and most opaque of substances, and one of the commonest of substances contains a great part of its weight of that which we consider as the most valuable.

But C. Guyton has done more. It is well known that iron is converted into steel by combining itself with a certain quantity of carbon. C. Guyton was desirous of ascertaining in what state carbon entered into this combination, and, above all, whether it abandons its oxygen to form steel:

C. Guyton

C. Guyton has declared in the affirmative. Agreeably to the views which directed Clouet in his discovery of making cast steel, C. Guyton changed soft iron into that steel with the diamond alone in a close vessel; and common charcoal did not produce steel but when treated with some agent capable of depriving it of its oxygen. Many poets have compared the hardness of the armour of their heroes to that of the diamond, without knowing that their comparison was founded on so real an intimacy. (See Phil. Mag. Vol. V.)

The same chemist has directed his attention to two metallic substances little known, though sufficiently abundant. One of them, named *nickel*, is not yet generally considered as a particular metal: some chemists think that it is only an alloy of several metals. C. Guyton is of a different opinion: he thinks that it may be possible to take from nickel all the iron with which it is mixed, and that it will even then retain properties hitherto found only in iron—that of attracting the magnetic needle, and that of becoming magnetic itself.

The second metallic substance he examined is *tungsten*; a word which signifies heavy stone, because some of its ores have a stony appearance. It is not long since it was known to be a metal, and hitherto it had been reduced and melted only in an imperfect manner. C. Guyton, having succeeded better than his predecessors, has found that the specific gravity of this metal is much less than what had been supposed; it does not much surpass that of copper. He is of opinion that tungsten can be of little use but by the property which its oxyds have of fixing vegetable colours.

The public has been informed a year ago of the success of the researches of C. Foureroy and Vauquelin on the stone of the bladder. This concretion, which occasions the most excruciating pain, and which the Faculty despaired of being ever able to dissolve, may be dissolved in certain cases by agents sufficiently mild not to injure the bladder. These two chemists have also united their efforts this year, and turned their attention to the liquid in which the stone is formed. Notwithstanding the numerous labours of which urine has been the object, they found in it new and very remarkable

markable things: they discovered in it a particular substance, to which urine is indebted for its colour, its taste, its odour, and, in a word, all its characteristic qualities. This substance, to which they have given the name of *urée*, has singular properties: by the action of fire it is changed entirely into carbonat of ammonia; it crystallises either alone or in union with the nitric acid; it is exceedingly soluble; but the strangest phenomenon is, that marine salt, which generally crystallises in cubes, is changed into octaedra; and that sal-ammoniac, which crystallises in octaedra, is changed into cubes when mixed with this substance. C. Foureroy and Vauquelin having remarked, in their analysis of *urée*, that it contains an extraordinary quantity of azote; that is to say, of that non-respirable part of our atmosphere which enters as an essential part into all animal substances; and, if I may be allowed the expression, that it was a matter too much animalised; have concluded that urine is chiefly destined to carry off the superfluous portion of this azotic principle which is found in the human body. Thus each of the elements of which the body is composed, is conveyed from it in a particular manner; the lungs free it from carbon in respiration, the liver from hydrogen in the production of bile, and the reins from azote in that of urine.

C. Chaptal has described the art of the scowrer, which, though despised because not lucrative, is, however, founded on knowledge and a multitude of facts which can be learned only from the higher branches of chemistry. (See Phil. Mag. Vol. V. p. 43.)

C. Chaussier has been so fortunate as to discover a new chemical production, and, at the same time, a useful remedy in various diseases:—it is a combination of sulphur with alkalies, in which the former is more abundant than in the usual hydro-sulfures, commonly called liver of sulphur, without being, however, in the state of an acid. The union is more intimate than in the hydro-sulfures; and this combination, which C. Chaussier calls sulphurated hydro-sulfure, has not the smell of liver of sulphur. The sulphurated hydro-sulfure of soda is formed on a large scale, when Glauber's salt, or sulphat of soda, is decomposed by carbon. This substance has been employed with success in some chronic diseases,

and, when dissolved in water, it may form a very good substitute for certain kinds of sulphureous mineral water.

C. Latreille has explained the habits and industry of a small bee, which does not live in society like our domestic bee. It does not build edifices like the common bee, remarkable for their matter and the geometrical manner in which they are constructed; but it knows, at any rate, how to render its small habitation agreeable. Bits of the petals of the corn-poppies, cut round and rolled up with art, forms a splendid tent with real purple curtains, in which it deposits an egg, with a portion of nourishment sufficient for the young one about to be hatched. Another insect described by C. Latreille is remarkable for the havoc it occasions, as it feeds only on the young of the domestic bees. It even searches for them when it is not destitute of other prey, and destroys a great many of these insects. It is of a genus which approaches near to that of the wasp:

C. Huzzard read to the Class the observations of the late Flandrin on animals bit by a mad dog. It appears from these observations that graminivorous animals, such as horses, cows, &c. may become mad when bit, but that they cannot communicate this horrid malady to others.

C. Champagne gave the following account of the labours of the Class of the Moral and Political Sciences during the last quarter of the year 7:—

C. Bouchaud read two memoirs on the colonies and municipia of the Romans. C. Bougainville read an account of the embassy of the five nations during the war of Canada in 1757. C. Mentelle read a memoir on the extent and population of the kingdom of Poland, and the increase of power which Russia, Prussia, and Austria have acquired by the partition of that country. It results from his researches, that Poland, before the first dismemberment, occupied an extent of 13510 square Polish leagues of 20 to a degree: that the population was 7,660,787 individuals, and 795 individuals to a square league: that the total amount of the taxes both direct and indirect was 37,173,237 florins, about 25,652,293 francs. The part which fell to Russia by the two partitions amounted to 6069 square Polish leagues, containing a population of 2,195,161 individuals,

individuals, with a revenue of 8,000,000 francs. Austria obtained an extent of 3876 square Polish leagues, with a population of 3,778,010 individuals, and a revenue of about ten millions of francs. The part of Prussia amounted to 4288 square Polish leagues, with a population of 3,764,509 individuals, and a revenue of six or seven millions of francs.

C. Lescalier read a memoir on the island of Madagascar. This memoir forms part of a voyage to India, which the author travelled through, and contains details respecting the population of Madagascar, its productions, and the industry and manners of its inhabitants. C. Lescalier has discovered, that the manners, customs, and, above all, language of the inhabitants of Madagascar, have a striking resemblance, notwithstanding the distance, to those of the inhabitants of Otaheite and the other islands of the South Sea.

C. Fleurieu read a memoir on the application of the decimal metric system to hydrography and the calculations of navigation.

C. Buache read a memoir on the lands discovered by La Peyrouse on the coast of Tartary and to the north of Japan. La Peyrouse explored the channel of Tartary, and his labour appears to be correct. He examined some parts of the land of Yesso, and confirms the truth of the discovery made of it by the Dutch in 1643, and the exactness of the description they have given of it. But the Dutch and Peyrouse only saw some points of that land, the great part of which still remains to be explored. The Russians had before made some voyages to Yesso; and it appears that it is not a large country, as the Dutch and Peyrouse imagined, but a group of several islands.

C. Lacepede, of the Class of the Physical and Mathematical Sciences, read a memoir on a new zoological chart. Naturalists, in treating of the different kinds of mammiferæ, birds, reptiles, and fishes, have pointed out, with care, the countries which they inhabit. But, to complete the history of animals, it was necessary that the naturalist should determine the influence which the different climates have in changing or improving their faculties and form, and in regard to the preservation or degeneration of the species. To obtain a solution to this important problem, the author traces out a zool-

logical chart, not according to the political or accidental divisions of the earth, but merely according to those physical boundaries which have been admitted by geographers. He takes his departure from the meridian of France, and divides the globe into twenty-six divisions, of sufficient extent to obtain sensible differences. By means of these comparable degrees, the naturalist will be able to ascertain the differences between animals, and even the variations in the same forms and species. This grand view of Lacepede, by leading to more exact descriptions and more accurate observations, will serve to give more extent to the science of the naturalist.

#### PHILOMATIC SOCIETY, PARIS.

C. Noel, in a memoir read in the Society, after taking a view of the advantages which might result from naturalising salt-water fish in rivers and ponds, and particularly the herring, pointed out the means to be employed for that purpose. These means are, to construct an artificial pond between two islands of the Seine, and to deposit in it herrings full of roes both hard and soft, which might be carried thither by one or more boats. To ensure the success of this first operation, the same boats might repair to the fishing banks, when the herrings have spawned, and take up a lading of fecundated ova to be carried to the artificial pond, with certain precautions which the author points out in his memoir. C. Noel mentions a great many instances which seem to prove that the herring is fond of fresh water; and, among other facts, he relates an experiment of Dr. Franklin, who stocked one of the rivers of New England with herrings by depositing in the water leaves of plants covered with ova. To add some force to the proofs adduced, C. Noel takes a view of the different kinds of fish which, by the art of man, have been transplanted from one climate to another.

C. Chantran read a memoir on the smut in wheat, and its acid. After remarking, that stalks which bear charred ears differ in nothing from others, and that these ears often contain good and bad grains, he thought himself authorised to advance, that this disease does not exist, as generally believed, in the germ of the seed from which they sprung. However, he does not consider liming the seed as useless; he thinks it

destroys the animalculæ attached to the seeds, and that the reason of its not entirely extirpating the smut is, because it cannot act on those small insects which occasion it, and which happen to be scattered in the ground.

Having analysed forty-six grains of smut, he found in this substance an acid easy to be demonstrated by such an analysis as could not possibly produce it in the course of the process. Thus, boiling water infused over it, gave a strong tinge of red to tincture of turnsole, while the remainder of this tincture retained its former character. Smut, deprived of its acid, and calcined in the open air, emitted the odour of burnt corn, and gave a residuum six times as large as the same quantity of the farina of wheat treated in the same manner. This joined to microscopic observations, says C. Chantran, proves the animal nature of this substance, and a difference between it and the farina of wheat, greater than could arise merely from disease.

The acid of smut is not volatile, and may be concentrated by distillation. With lime and with ammonia it forms an insoluble salt. This last character distinguishes it from the phosphoric acid. Combined with pot-ash, it gave a salt crystallised in small deliquescent needles of a bitter taste. It decomposes carbonat of lime.

#### LYCEUM OF THE ARTS, PARIS.

In the sitting of the 24th of Pluviose, Feb. 13, C. Bruley read a note respecting the Nopal, called commonly in the Antilles *Bois des Indes*, and which nourishes the insect that produces cochineal. He announced at the same time a very singular phenomenon, which is, that in the *Jardin des Plantes* at Paris there are several nopal plants, brought to France by C. Delahaye, covered at present with insects exceedingly voracious; from which it is expected that cochineal may be cultivated in the neighbourhood of Paris sufficient for the consumption of the French manufactures. C. Bruley promised to present, at the next sitting, nopal plants covered with the living insects, and a piece of scarlet cloth dyed with Parisian cochineal, which, he said, was equally beautiful as that dyed with American cochineal.

**CHILD FOUND IN A SAVAGE STATE.**

Many of our readers must recollect the particulars respecting Peter the wild boy, found in the woods in Hanover, who was afterwards maintained in this country at the expence of Government, and who died some years ago: they will also be able to recollect the wild girl found in the woods of Champagne in France: both of which instances were employed, among others, by Lord Monboddo to support his whimsical idea that mankind originally went on all-fours. Another instance of a wild individual of the human species has recently occurred, as appears by the following extract of a letter from the administrator of the hospital of Saint Afrique, which we copy from a late French journal:—

“ The attention of the inhabitants of this commune has been attracted this morning by a very singular phenomenon. A child, caught in the woods of Lacaune by three huntsmen, was brought to our hospital, of which I am one of the administrators. On their approach, this child, which was quite naked, betook itself to flight, and climbed up a tree. When brought to Lacaune, it made its escape; but it was again caught in the woods in the neighbourhood of Saint Sernin, and carried to the house of C. Constans, Saint Esteve, commissioner of government. The soldiers who attended it thither assured me, that it was caught in the manner above related. It is certain that it feeds only on potatoes and nuts. If you give it bread, it smells it, bites it, and then spits it out: the case is the same with other kinds of aliment. From these facts there can be no doubt that it has lived a long time in the woods. But how was it able to withstand, while quite naked, the severity of the present winter in the woods of Lacaune? This is the highest and coldest mountain in this part of the country, and the cold was greater this year than in 1795. This child seems to be only ten or twelve years of age at most. It is well shaped, and its eyes are black and lively. It is always endeavouring to escape. This morning, having suffered it to go out into the fields contiguous to the hospital, it began to run as fast as it could, and, if it had not been closely followed and caught, it would have soon gained

gained the mountain and disappeared. We have made for it a small dress of grey cloth, by which it seems to be much embarrassed, and which it does not know how to get rid of. We suffered it to go out into the garden, but it endeavoured to escape, and attempted to break one of the bars of the gate, which is of lattice-work. It does not speak. When offered potatoes, it takes as many as its pretty little hands can contain. If they are boiled (for it prefers them so) it peels them, and eats them like an ape. It laughs in a very agreeable manner, and, when robbed of its potatoes, sends forth a shrill cry. Constans imagined that it was deaf, but we have convinced ourselves of the contrary; at most, it is only dull of hearing."

#### BOTANY.

C. Broussonet, the French vice-consul at Mogador on the coast of Barbary, having been obliged to abandon his situation on account of the bad treatment he experienced and the ravages occasioned by the plague, and to retire to the Canaries, has employed his leisure time in examining the soil and productions of these islands, of which he proposes to publish a natural history. In one of the isles he found the glacial *mesembrianthemum cristallinum* Linn. cultivated on a large scale by the inhabitants, to whom it furnishes abundance of soda. Broussonet observed in the island of Teneriffe eight kinds of laurel, several of which appear to be new.

#### METEOROLOGY.

" On the 11th instant there was a very curious phenomenon here; an incessant shooting of the stars from 11 o'clock at night till day-light the next morning, described by some as a shower of fire; it was, indeed, magnificently awful."

" Barbadoes, Nov. 24, 1799 "

On the 6th of December a curious phenomenon was observed at Aosta. At ten in the morning, two parhelia, or mock suns, were seen, of the same size as the real sun, but somewhat paler. One of them had a long white tail, in shape resembling a sword. An hour afterwards, the three suns formed a semicircle, the real one being in the middle. This semicircle soon changed into several others, and at length six

of them were seen one above the other. These also vanished again, but the two parhelia remained. At four in the afternoon, previously to the setting of the sun, the mock-sun in the west disappeared, and afterwards that in the east.

### VON HUMBOLDT'S EXPEDITION TO SPANISH AMERICA.

The two following letters from this indefatigable philosopher to one of his friends in Germany, have been published in one of the foreign journals:—

Corunna, June 3, 1799.

I wrote you from Marseilles, that I had been disappointed in my hopes of undertaking a voyage round the world with Captain Baudin (to which I had been invited by the French Government) just at the moment when I was going down to the port to embark. After this I proposed to go out to Bonaparte with the second expedition from Toulon, and my friends were anxiously expecting me; but this expedition was rendered impossible by the battle of Aboukir. Firm to my purpose, I then wished to go by a Swedish frigate, expected at Marseilles, to Algiers, in order that I might undertake, with the caravan of Mecca, that dangerous journey through the desert of Selima to Cairo. The frigate, however, did not arrive; and, after waiting two months to no purpose in Provence, as war had broken out between France and Algiers, I proceeded to Spain. I had procured recommendations to the king, and received from him what no foreigner ever obtained—letters of recommendation to all the viceroys, and permission to traverse all the Spanish settlements with my instruments.

You must acknowledge that I have been exceedingly fortunate. I have been provided with every thing necessary, and in a few hours shall sail, in the Spanish frigate Pizarro, for the Havannah; from which I intend to proceed to Peru, Mexico, and Chili. I shall be absent for several years, but I flatter myself with the hopes of accomplishing something of importance.

Bonpland, a young French botanist, accompanies me. I shall write you from the Havannah.

ALEX. VON HUMBOLDT.  
Orotava

Orotava in the Island of Teneriffe,

June 24, 1799.

We left Corunna on the 5th, and arrived, without any accident, at Lancerotta on the 16th, and St. Croix, in Teneriffe, on the 17th. We were in sight of four English frigates, which we escaped, but we cannot tell how.

I have examined the peak with great attention; I was almost in the crater at the height of 11,500 feet. This excursion was attended with more fatigue than danger.

We found the heat of the crater on the ground  $70^{\circ}$  Reaum. and the air at  $2^{\circ}$ . The pumice-stone, which has occasioned so much dispute, is obsidian-stone fused and decomposed. It is here as clear as the day. I am so tired that I must conclude my letter. We are just going to set out for Carracas and the Havannah.

ALEX. VON HUMBOLDT.

#### **NOURISHMENT BY ABSORPTION.**

Dr. Van Mons, of Brussels, has lately announced the following circumstance:—Having a patient under his care, who, on account of a wound in the throat, was incapable of swallowing any kind of nourishment for several days, he kept him alive during that period by applying to the skin, in different parts of the body, several times a-day, a sponge dipped in wine or strong soup. He concludes from this fact, that the absorbing vessels of the skin are capable of conveying the fluids communicated to them to the interior parts of the body, as the latter convey the assimilated nourishment to the blood. It should be remarked, however, that from Dr. Rollo's experiments on diabetic patients, it did not appear that water was absorbed by the skin: but this may have been owing to something peculiar in the absorbent system of such patients; for one of our own navigators (Captain Inglefield or Bligh, we do not recollect which,) kept their companions from perishing of thirst, by applying sea-water to the skin.

#### **GASEOUS OXYD OF AZOTE.**

We have seen this gas inhaled: it seems to produce, through the medium of the lungs, the same effect that alcohol does through the medium of the stomach—intoxication.

tion. Does not this intimate, what would be little expected, that it probably contains a large portion of hydrogen?

## DEATH.

At Paris, on the 23d of October last year, at the age of 77, Louis James Gouffier, member of several learned societies. He was born in 1722, and applied at a very early period to the study of the mathematics. His first labours were, to arrange and superintend the publication of the memoirs, which the celebrated Condamine gave to the public in 1751, on the measurement of the three first degrees of the meridian in the southern hemisphere. In consequence of the ability which he displayed by the part he took in this interesting work, he was invited to co-operate in the Encyclopedie with Diderot and D'Alembert. Being charged with the part respecting the mechanical arts, Gouffier exercised several of them himself, that he might be better able to give a description of them; such as those of watch-making, lock-making, cabinet-making, turning, &c. His articles display clearness, precision, and method. About the year 1760, the Baron de Marivet invited Gouffier to reside with him, in order that he might improve himself in natural philosophy. In 1779 they distributed the prospectus of a New Philosophy of the World, which they proposed to publish conjointly, and which was to make fourteen volumes in quarto; but it was never carried farther than the eighth. Gouffier was fond of travelling on foot, and in this manner went over all France. He had a great attachment to hydraulics, and was acquainted with every river and canal in the kingdom. With the same Baron Marivet he published, in 1789, a work, in two volumes octavo, on the Internal Navigation of France, with an Atlas adapted to the subject. He invented several curious pieces of mechanism, among which is a mill with portable arms for sawing planks. This piece of mechanism was sent to Poland to serve as a model for the mills destined to manufacture the timber of the immense forests of that country. He invented also a water level, much used by land surveyors.

THE  
PHILOSOPHICAL MAGAZINE.

MARCH 1800.

I. *Observations respecting Oysters, and the Places where found.* By Professor BECKMANN.

OUR knowledge respecting the nature and organisation, mode of life, nourishment and propagation of these shell-fish, is confined, defective, and uncertain. They live in a medium which screens them from our observation; they are found on coasts which few naturalists frequent, and are so different from all other animals, that, even from the observations which have been made on them, very little can be concluded. I shall leave it to naturalists to collect, arrange, and explain these observations, as the following, in my opinion, will be sufficient for the object I have in view by the present paper.\*

Oysters live on the shores of the sea, and particularly such as are sandy or stony; on the coasts of islands, on rocks which project into the sea; and on sand-banks; but they seem to thrive best at the mouth of streams, where the water of the latter renders the water of the sea milder. The animal slime which the streams carry along with them, and which is accumulated on the shores, may serve them as food.

Oysters spawn chiefly in spring, when the sun again begins to warm the water of the sea; and what they then throw out consists in small oysters completely formed, which seem to

\* *Ostrea edulis LINN.*

be innumerable. Each of these young ones expands to a complete oyster, in the same manner as the seeds or fruits of those plants which have hermaphrodite bloom. I must here observe, that those are mistaken who speak of male and female oysters; for how could procreation be possible among animals which either do not change their place during their whole lives, or can change it only perhaps for an inch, and which are capable of no other movement than that of opening a little their shells?

These shells are very often covered with productions of the coral kind: they are frequently loaded also with small muscles and multitudes of worms, but only on the convex side, which appears to be the upper one, so that the animal rests on the flat side. It frequently happens that both shells are quite pierced through, and gnawed by worms, in the same manner as old wood. All these enemies endeavour to destroy these harmless animals, and the case is the same with the worms which are found between the fleshy parts of their body, and in many places more abundant than in others\*. A more formidable enemy for oysters, however, is that eel-formed fish which at Heiligeland is called *nugnogen*, but which by some has been called the five-singered fish †. It is found sometimes in oyster-shells that are quite close, and in which no traces can be discovered of the first inhabitant. It lies in the shell bent like a ring, and the fishers unanimously assert that it eats the oyster. On that account the

\* Besides these worms, there are found, on shells which have not been long taken from the sea, another kind, exceedingly small, which emit a phosphoric light, that may be observed when they are thrown against a hard body in the dark, or suffered to fall on a stone. They are mentioned by Lemery in his Dictionary of Drugs. It appears to me that they are perfectly similar to those which I have seen drawn up from the sea on ropes. Linnæus gives to this species the name of *Nereis noctiluca*.

† *Ophidion imberbe*, a name borrowed by Linnæus from Rondelet. Besides the writers quoted by Linnæus, I shall refer the reader to *Gesneri Hist. aquatil.* p. 105, under the *Afelli*. In Klein, p. 55, it is called *Eucbelyopus flavus imberbis*. Schelhammer's *Anat. Xiphiae*, who had the *nugnogen* in his possession, may be found in *Velenini Amphitheat. Zootomicum*, II. p. 109. A bad figure of it may be seen in Rozier's *Observations sur la Physique*, XII. 1778; p. 277. See also, *Transactions of the Swedish Academy*, Vol. V. p. 122, and Vol. VI. p. 116.

English fishermen strongly recommend destroying it wherever it is found. But how comes this murderer into the shell? In all probability it creeps in when the animal opens its shell, and I thence conclude that the oysters open their shells much wider than Reimarus\* and others have imagined. Another question is, How happens it that the ancient ichthyologists, though they mention this fish, do not observe that it was found in oyster-shells, which at present is not uncommon?

Oysters are leanest when they spawn, or after that period, and on this account fishing for them at that time is forbidden in England and other countries where prudent regulations prevail. In Spain this precaution is employed because it is imagined that at this period the use of them as food is injurious to the health. It appears that they ought at least to be three years old in order to serve as food †; and where care is taken for the preservation of the oyster-beds, the fishermen are ordered to scrape off all the small ones which adhere to those that are full grown, and to throw them back into the sea. An old oyster has often twenty small ones attached to it. Very severe winters injure the oyster-beds and destroy the oysters, as was every where proved during that of the year 1740. Violent storms in the spring are equally prejudicial, and many beds have been exhausted by fishing up too many from them. We are told by Paulus Jovius ‡, that he remembered the time when oysters were brought from the coast of Pesaro to Rome; but that these beds were afterwards entirely exhausted, and that people were obliged to be satisfied with oysters brought from Corsica, which, before they

\* *Betrachtungen über die besondern thierischen Kunstrieben*, p. 17.

† It is generally believed that the shells of muscles receive yearly a new coat, and from the number of these their age may be determined, as the age of a tree from the number of its rings. But Poli, in his expensive work on the Testaceous Animals of both the Sicilies, the first part of which was printed at Parma in 1791, assures us, that he observed that their size does not increase in such a regular manner as to admit of their age being determined by it. In England the smallest oysters are called oyster-seed, *cultch* and *spat*.

‡ *De Romanis piscibus*, cap. xli. p. 139.

arrived, were often in a putrid state. No kind of animal substance, indeed, is more liable to corrupt than shell-fish, both those which are used as food, and those which are not.

It is an undoubted truth, that the nature of the shell and fish, as well as the goodness of these animals, are different according to the bottom where they are found; so that fishermen can tell by their external appearance, and connoisseurs by the taste, where any kind of oyster, and in general of shell-fish, have been found. Where the bottom is calcareous, they are tenderer and more friable; where it consists of rock, they are thicker, more solid, and heavier; where it consists of marl, or a mixture of chalk and clay, they are less earthy, softer, and contain more animal gluten. On a slimy bottom they are more oily, and abound more with rich animal particles. The taste is equally liable to change: for example; on the eastern stony shore of the Adriatic Sea all marine animals are poorer and more insipid than those on the western side, where the bottom is richer. On calcareous rocks the oysters are larger, but have not so good a taste as those which live in slimy bays or creeks. In Norway those are least esteemed which are found on a muddy bottom, because they have a muddy taste: those of Denmark, found on a sandy bottom near Tondern and Fladstrand, are much better. The best are the so called rock-oysters, found on the rocks where they are alternately covered and left dry by the tide, though in England those found at the greatest depth in the sea are preferred. The rock-oysters are larger and plumper than others, but their shells much thinner, and many of them so thin that they are as transparent as horn. For this reason, a cask such as those used at Bergen will contain scarcely 400, or even 300, sand-oysters, but is capable of containing from 700 to 800 rock-oysters.

The oyster fishery is exceedingly simple, and requires very little apparatus; many collect the oysters with their hand, that is, where the sea retires and leaves the bottom dry. Where this is not the case, a square iron box, or box bound round with iron, is dragged over the bottom by means of a rope, and from time to time drawn up and emptied.

Others,

Others, instead of this box, have a net made of strong leather thongs, kept open by means of a heavy square iron frame, which, by being dragged on the bottom, rakes up the oysters and suffers them to be received into the net. Others have a rake with about twenty strong iron crooked and blunt spikes eight or ten inches in length, which is fastened to a long thin elastic pole. The fishermen, who are in a boat, draw this rake over the bottom in the same manner as the before-mentioned net, and thus raise the oysters, which are retained by a board fastened over the rake, so that they can be drawn up with it. The pole must be sufficiently pliable to yield when drawn with force over the inequalities of the bottom. In places where the fishermen employ more care in collecting the oysters in order to spare the banks, they pull up, by means of wooden tongs, when the water is clear, only the largest oysters, and suffer the rest to remain undisturbed till they grow to the proper size. There may, however, be other means employed for catching oysters with which I am not acquainted; and it would be a useful labour if any person would give a complete treatise on the oyster fishery, with engravings of all the apparatus and instruments. This, as far as I know, no one has ever yet done. Duhamel promised to treat of this subject in his large work on Fishing, but he died before it was completed.

Those oysters which are distinguished by a green colour, and which the Dutch on that account call *groenbaardjes*, are considered to be superior to others. But this distinction is not natural to them, and is produced by art. For this purpose pits are dug on the sea-shore, and furnished with small sluices, through which the sea-water is suffered to enter at the time of the spring-tides. When the water has risen to a certain height the oysters are thrown into the pits, where they are left till they acquire the proper colour. This stagnant water, in warm weather, soon becomes green, and in a few days the oysters assume the same colour; but they do not acquire their full quality, and become fit for sale, till the end of six or eight weeks. I am inclined to think that this colour is occasioned by certain plants which grow in the water, perhaps an *ula*, *conserva*, or *tremella*. This was the opinion

nion of Bradley \*, who calls the plant a sort of cow's milk; a name which, according to Hudson's *Flora Anglicana*, is a *Conferva rivularis*. I must here remark also, that the *Ulva latifissima* of Linnaeus, which by Gmelin in his *Historia fucorum* is called *Fucus tremella lactuca*, is by the English called the oyster-green. The objections which some English writers have made to this opinion seem to me to be of little weight. They assert, that when, in the neighbourhood of a greening-pit, another is formed at the distance of about a foot, the water never becomes green in the latter; and that pits which have been a certain time green, and have communicated that colour to oysters, sometimes lose their colour. But all this, even if true, might, on more accurate observation, be explained from the vegetation of these plants.

In Europe the English oysters are accounted the best; and these, as the French believe, have been produced from oysters formerly fished up in Concale Bay, near St. Malo, and transplanted to the English coast: but of this assertion we have no proof†. Those, however, are most esteemed which are found on the coast of Essex: from that coast the brood is transplanted to the sea near Colchester, where the Coln, which flows through the city, forms a great many arms and small creeks exceedingly proper for breeding them. A great many of these oyster-pits are found at the village of Row Hedge, in the parish of East Doniland; and the sale of oysters forms a considerable branch of trade to the whole neighbourhood‡. After the month of May, however, no seed must be taken from the banks, because it is known, from experience, that in that case muscles and cockles would breed there and destroy the oysters. People who infringe on this regulation are severely punished by the Admiralty Court, which has all the oyster banks under its inspection. All these oysters are in high request, under the name of Colchester oysters. The best come from Purfleet; they are exceedingly

\* A Philosophical Account of the Works of Nature, London 1739, 8vo. p. 72.

† Lettres de l'Abbé Le Blanc sur les Anglois et les François, Arsfeld. 1747, 12mo, Vol. III. p. 281.

‡ Morant's History and Antiquities of Essex, London 1763, fol. p. 186. plump,

plump, and the shells are thin and almost transparent. The best kind, however, even at Colchester, are so dear that a peck costs five or six shillings; and as the London fishmongers buy almost all their oysters from the fishermen or dredgers immediately after they are caught, they all, of course, pass through their hands. But they are accused of mixing fresh with stale oysters, and of selling those of the western coast for Colchester oysters.

Many, however, prefer those oysters which are collected on the coast of Dorsetshire, and particularly those found near Pool. They are said also to contain sometimes pearls of larger size than those found in other places. The greater part of the English oysters, which the Dutch carry away every year with more than a hundred vessels, are sold by the fishermen at Faversham, a small town in Kent, to the north-west of Canterbury, and which, like the neighbouring small towns of Milton and Middleton, is known on account of this trade. There are a great many oyster banks also in the Isle of Wight: those, likewise, are well known which are found near Tenby on the coast of South Wales, and near Milford-Haven: but the largest, and perhaps the worst, are those of Blackrock, near Liverpool.

It appears that the English have taken more trouble than other nations, not only to maintain their oyster banks, but to form new ones. Since the year 1712, a great many oysters have been found in the small channel of Meneu or Menai which separates Anglesey from Caernarvonshire, and where about the year 1700 none were to be seen. It is known, however, that soon after that period some person threw into the above channel about a hundred oysters, which have now extended several miles, so that at present a great many vessels are employed in this fishery \*. It would appear that the waves carry the feed along with them, as it is known that on the coast of Holstein the banks are destroyed by violent storms about the time the oysters spawn.

[To be continued.]

\* Some account of the English oyster banks may be found in the Transactions of the Swedish Academy, Vol. V. p. 122, and Vol. VI. p. 116. Also in the *Journal Economique* 1753, Dec. p. 166 and 179; and 1757, p. 177. See also the History and Antiquities of Colchester, by Phil. Morant, Lond. 1748, fol. Vol. I. p. 87; and Sprat's Hist. of the Royal Society, Lond. 1722, p. 307.

*II. History of Astronomy for the Year 1799. By JÉRÔME LALANDE. Read at the Lyceum on the 26th of December.*

[Concluded from Page 41.]

**T**HIE Geographical Ephemerides of M. Von Zach, which appear every month, have continued to establish a valuable correspondence between the astronomers of Germany and those of the rest of Europe; but this work seems to have done more by procuring to astronomers new amateurs and new assistants in regard to observations and calculations; such as Colonel Le Coq, of Minden, in Prussia; M. Felgenhauer, at Reichenback, near Schweidnitz, where he has established an observatory furnished with excellent instruments; M. Berhnauer, at Budissin or Bautzen, in Lusatia; M. Crillo, at Wettin, in the duchy of Magdebourg; and M. Gauß, at Brunswick, a young man who shews great taste and zeal for astronomy, and who has made useful calculations.

In Russia, two officers of the navy have been sent to determine the position of various points on the White and Frozen Seas. The President of the Academy, Baron de Nicolay, a German from Strasburgh, and a poet, seems to be interested in this undertaking.

The beautiful instruments of Megnić, among which are an azimuth quadrant, have been purchased by C. Lubbert, of Hamburgh; and he has given me some hopes that he will establish an observatory, where they may be rendered useful. The Senate of Hamburgh having resolved to cause a correct map of its territory to be made, M. Horner has set out from Gotha, where he laboured in the observatory, and has gone to Hamburgh.

The Duke of Gotha has purchased new instruments for his beautiful observatory, and M. Von Zach continues the printing of a valuable work, in two volumes quarto, on the Stars; which will soon appear.

In the Batavian Republic, C. Calkoen has gone to take possession of the observatory of Leyden, and has left that of Amsterdam to C. Keyser; but we have received no observations except from C. Dutenhove at Utrecht. The last men-

vioned astronomer has caused to be printed the Cosmologic Letters of Lambert, translated by C. Darquier.

A grand telescope of 25 feet has been constructed by Dr. Herschel for Spain; it cost 175,000 francs, (above 7000*l.* sterling); but there is no observatory at Madrid; that of Buen-retiro is not yet finished. The minister Florida Blanca had much at heart a museum and observatory, but the architect finished neither of them. When the war broke out, the minister was dismissed, and astronomy in Spain has remained in its former state of torpor. There is so little money in that country, that it is difficult to find enough to defray the smallest expences. But the minister Durquijo seems to be much disposed in favour of astronomy, and, in the mean time, has enabled M. Chaix to make useful observations. I have thanked him in the name of Astronomy, and he returned such an answer as increases my hopes.

M. Chaix has been charged in Spain with a labour on measures; and we have sent him from Paris an account of what was done by Borda, Mechain, and Cassini, in regard to the measure of the pendulum, which in 1792 was found to be 36 inches 8 lines 60 at  $10^{\circ}$ , which is the mean heat at Paris. This supposes the pendulum in *vacuo* reduced to very small arcs. We learn from the Journal of Jena, that the first volume of the Memoirs of the Academy of Lisbon was published in 1797; it begins at 1780. It contains observations made at Lisbon by M. Custodio Gomes de Villasboas, and M. Ciera; by M. Ceruti at Carthagena, and by M. Dorta and Barbosa at Rio-Janeiro; meteorological observations made at Rio-Janeiro; observations of the satellites, made at Mafra; an eloge of d'Alembert, by M. Stockler; but this eloge has excited persecution against the author in a country where the anti-philosophic tribunal still calls itself the Holy Inquisition.

An able artist at Florence, named Gori, has divided, with great ingenuity, a quadrant belonging to the observatory of P. Ximenez, occupied by the Scolopies, and which had originally been very ill divided. We may hope, therefore, for some observations from Tuscany.

The revolution of Naples has made that capital, the position

sition of which was not accurately known, an object of attention. M. Cassella sent me several observations of eclipses, which I have calculated; and I have found the distance of Naples from the meridian of Paris, by the mean of seven results, to be  $47' 49''$ .

The labours of M. Piazzi, of Palermo, must have been interrupted this year by calamity and misfortunes; for I have received no letter from the beautiful observatory and the able astronomer of Palermo.

A Roman citizen has come to reinforce astronomy in France. C. Ciccolini requested leave to lodge in the Collège de France, in order to observe and make calculations along with us. He has displayed in this situation as much zeal as ability; and we are indebted to him for the calculation of eclipses of the sun observed in this century, of which there had before been no results. He has assisted us also to calculate a part of our immense collection of stars.

I announced last year that Cassini seemed disposed to tread in the steps of his ancestors. His father, who quitted the observatory at the fatal period of 1793, has announced his intention of residing at Paris; and the Institute has elected him a second time to a place in the department of astronomy, vacant by the death of C. Lemonnier.

C. Sorlin has joined us, and is calculating the longitudes, latitudes, and angles of position of six hundred stars, which form the fundamental catalogue of the principal stars which C. Le Français is publishing in the *Connoissance des Temps*, and which he has for several years been bringing to perfection. C. Sorlin has calculated also a new table of the spheroidal degrees according to the dimensions we have adopted.

C. Mougin has calculated the precessions of the 1500 stars in the *Connoissance des Temps* for the year 7, in centièmes and seconds; and he is calculating for 1800 and 1900 the precessions of the 600 stars of the fundamental catalogue.

C. Bernier of Montauban has sent us calculations of observations of Mercury and Venus made by C. Duc-la-Chapelle.

Several dissertations have appeared in the public journals on the question, whether the year 1800 begins the nineteenth century.

century. In 1700 there were many papers on the same subject; but it is sufficient to consider that centuries are counted like every thing else, from one to a hundred, and therefore it is 1801 that must begin the new century. The only thing that could occasion this error is, the transition from 17 to 18 hundreds. It has appeared to many people that this is changing the century!

C. Taillardat has published a small work entitled *Horloge du laboureur*, or an easy method to discover the hour of the night by the aspect of the stars, with figures of the constellations, and the months when they are seen in the evening.

The Marine, which is intimately connected with Astronomy, has produced a memoir containing theoretic explanations of a trigonometrical chart for reducing the apparent distance of the moon from the sun or a star, to the real distance, and to resolve other problems of navigation, by C. Maingnon, *lieutenant de vaisseau*. This memoir, and the chart by which it is accompanied, contain an ingenious, easy, and correct method of reducing distances with a scale and compass on one chart, instead of the great number which have been published by Margets; and the report which C. Leveque has made to the Institute on this subject displays great erudition, and contains important reflections.

C. Leveque has published also, in the *Connoissance des Tems* for the year 10, an interesting memoir on the use which may be made of the horary charts of Margets for resolving problems, which the author had not in view, and which render them more interesting than was imagined.

The *Bibliothèque Britannique*, an excellent journal, published at Geneva, contains an extract of several reports made to the Society established in that city for the advancement of the Arts, on the going of a marine time-keeper, executed last year by two Genevan artists, Denole and Magnin, and submitted by them for examination to that Society, who appointed a commission to follow, at the observatory, the going of that time-piece.

It is in the form of a cylinder, three inches in diameter and 18 lines in height, and is suspended horizontally in a double circle, after the manner of the marine compasses. It

has a compensation balance, according to the principles explained in the same volume of the *Bibliotheque Britannique*\*. It is moved by a spiral spring rolled up in the form of a cylinder. The escapement is described in the same work, and illustrated with figures. All the frictions, both of the escapements and the parts of the machine, are performed on rubies either plain or pierced; and this essential improvement, which renders the use of oil unnecessary, had never before been carried to the same degree of perfection.

These able artists improved themselves by a residence of several years at Paris with Ferd. and Louis Berthoud: they afterwards united their talents at Geneva, to the great advantage of an art in which they have so eminently distinguished themselves. C. Magnin is now travelling through Spain, to which he has carried a time-keeper like that above described. They make also portable chronometers, with an escapement independent and a compensation balance, which go exceedingly well.

The art of piercing rubies, formerly carried from Geneva to England by Fatio, was a secret lost to the country in which it was invented. These artists have again naturalised it, for they cut and pierced themselves all the rubies they employed.

C. Louis Berthoud has also brought a workman to Paris, and he will do the same thing in future in regard to the chronometers with which he will enrich the navy. The minister has entrusted me with one, the exactness of which is of the utmost value for the correspondence of the five observatories of Paris.

I hoped that my aerial voyage, on the 25th of July 1799, would have procured me some knowledge respecting the scintillation of the stars and the nature of the atmosphere; but I was deceived by the person to whom I gave my confidence, and for whom I braved the public opinion. I was not able to ascend to a sufficient height, but this atmospheric promenade enabled me to make some useful remarks on aerial currents. On setting out from Tivoli the air appeared to me perfectly calm, and there did not seem to be the least wind, yet I perceived that the balloon advanced towards the east. I

rose to the height of 250 toises, and advanced at the rate of six leagues *per hour*. The direction of the clouds, which I had examined before I set out, was, on the contrary, towards the west: thus I experienced, that when a local cause impels the lower part of the atmosphere towards the west, that above takes its place, and proceeds towards the east. Of the two balloons which I sent off before me for the sake of trial, one rose to the height of 300 toises, and directed its course towards Monfort; the other rose to about the height of 600 toises, and proceeded towards Rambouillet, which made six degrees of difference. Thus, in 300 toises the wind changed six degrees. By rising, therefore, more or less, we shall one day be able to vary our direction. The inclined planes of C. Tetu Bresli, at Bellevue, afford us the means of varying these directions much more; and I hope that a proof of it will be seen next summer.

A large balloon of nine feet, which was let off next morning, rose much higher, and fell at Coucy, 23 leagues to the north-east of Paris, having proceeded at the rate of eight leagues *per hour*. It directed itself towards Maestricht and Ruremonde, while the clouds were proceeding in the direction of Joinville and Constance towards the south-west. Between the two directions one might have chosen for every part of Germany. Thus, the project which I had announced of going to Gotha was not chimerical, as asserted; nothing would have been necessary but to choose the height. The velocity of eight leagues *per hour* was indicated also by the excursion of Garnerin on the 28th of Thermidor, year 6, who went from Rosni to Chalons in four hours. Twenty-four hours, therefore, would have been sufficient to go to Gotha, which was the term of my desires and my hopes.

My aërostatic globe turned six times, which shewed, that in a current of air of twenty feet in height, there is a sensible difference of force and velocity; but probably by rising much higher, I should have found more regularity.

I saw also, by the agitation of my barometer, that the stability of the boat was not sufficiently constant to enable me to observe it with my glasses; but at a greater height I should, without doubt, have found more stability: besides, as on

board ship, we might employ instruments, which would obviate the inconvenience of motion.

There have been periods when an astronomer would have been glad to rise above the clouds. Le Gentil went to India in 1760 to observe the transit of Venus: by the war he was deprived of an opportunity of observing that of 1761; he was obliged, therefore, to wait for that of 1769; but he was again disappointed by clouds. He had travelled then ten thousand leagues, and employed ten years for an observation which he did not make. If he had been in possession of an aërostatic globe, this long voyage would not have been lost to astronomy; and, as astronomers, we have reason to congratulate ourselves on the noble discovery of Montgolfier.

The frost, during winter, afforded an opportunity also for meteorological experiments. C. Fourcroy repeated that of the congelation of mercury: at 30 degrees it began to lose its fluidity, and at 32 became solid.

It now remains for me to speak of the losses which astronomy has sustained this year. The first, and most remarkable, is the death of John Charles de Borda, on the 19th of February 1799. He was born at Dax on the 4th of May 1733. He was first in the light horse, and afterwards in the engineers. In 1769 M. De Roqueseuil induced him to enter into the navy, where his mathematical knowledge might render him of more utility. In 1754 he was received into the Academy of Sciences, where he was always considered as one of the first geometers. In 1771 he undertook a voyage to America, in the Flora, with Verdun and Pingré. The results appeared in 1778 in two volumes quarto, the greater part of which were due to his labours. In 1774 he undertook a voyage to the Azores, the Cape Verd islands, and the coast of Africa. The manuscript exists, and contains many observations, which render the publication of it desirable. I do not speak of his learned researches on the resistance of fluids, which are in the memoirs of the Academy for 1763 and 1767, since I have nothing to recall here but what he has done for astronomy and the marine. But C. Lefevre Gineau will read publicly in the Institute a more particular éloge of this illustrious academician. By serving

In the American war with d'Estaing in 1777 and 1778, his health was impaired, but he still employed himself in useful labours. In 1778 he introduced into astronomy and the navy multiplying circles, invented by Tobias Mayer, of the importance of which no one had before been sensible. He brought them to perfection, and by these means rendered an essential service to astronomy and navigation.

In 1792 he invented instruments and methods for observing the length of the pendulum, with a precision before unknown; and metallic rules for measuring bases, intended to give the real length of the meridian. These instruments were of great utility for that great and important labour. As refractions were necessary in this labour, he made experiments and theoretical researches worthy of a great geometer. They are preserved among his papers, and a large memoir by him is ready to be printed.

He caused to be calculated at his house, and at his own expence, the logarithms of the decimal parts of the circle, according to the new division into 400 parts; and defrayed the expences also of printing. The publication of it is impatiently expected.

I have published in my Abridgement of Navigation his new method for gauging vessels, together with the tables. He was inspector of the dock-yards: in this situation he was useful, and Government had the greatest confidence in his talents.

C. Lemonnier died at his seat at Herils, near Bayeux, on the 2d of April. He had been lost to us ever since the 10th of November 1791: three years ago I gave an account of his useful labours, but the last epoch of this memorable life ought to be consecrated in the present history. I wished to insert in the first volume of the *Histoire Céleste*, now printing, a part of the observations of my illustrious master: nothing would have been so desirable as to render this testimony to his memory, which would have been at the same time a testimony of my gratitude; but I was not allowed, notwithstanding my zeal and entreaties, to have any communication with his manuscripts: I do not know what will become of them in hands foreign to astronomy, and which seem as indifferent

different for the glory of a father as for the sciences, which he cultivated for fifty years with so much success.

Joseph Liesganig, formerly a Jesuit at Vienna, died at Lamberg, in Austrian Poland or Galicia, on the 4th of March 1799, at the age of 81. We are indebted to him for the measurement of degrees in Hungary and Austria in 1769. He came to see me when I passed through Venice in 1765, and I then admired his talents and zeal.

On the 24th of February we lost Professor Lichtenberg, at Gottingen, to whom we were indebted for the posthumous works of Mayer in 1775.

M. Strnadt, (we pronounce Strenat,) the astronomer of Prague, long known by many useful observations, died on the 24th of September. Bernoulli, when he gave an account in 1776, in the first volume of his *Nouvelles Litteraires*, of the memoirs printed at Prague, announced that there were among them memoirs of M. Stepling, who was director, and, in some measure, founder of the observatory, and of M. Strnadt, who was his assistant. Since that time he never ceased to observe, as may be seen in the Ephemerides of Berlin, and in other works. M. David, his assistant in the observatory, has succeeded him as director.

We have learned also from Sweden, the death of I. H. Lindquist, Professor of Mathematics at Abo in Finland, who has published, in the Transactions of the Academy of Stockholm, many interesting memoirs.

On the 17th of November 1798, we lost a valuable amateur of astronomy, the bishop of Transylvania, Count de Bathiani, who established an observatory at Carlsbourg, to which he has bequeathed 30,000 florins and a beautiful library. He was born on the 30th of January 1741, and was made bishop on the 25th of January 1781.

The bishop of Erlang (Agria) Count Charles Esterhazi, founder of the observatory where M. Madarassy observed, died on the 6th of March 1799.

*III. On the various Effects produced by the Nature, Compression, and Velocity of the Air used in the Blast-Furnace.*  
*By Mr. DAVID MUSHER, of the Clyde Iron-Works.*  
*Communicated by the Author.*

[Concluded from Page 70.]

I HAVE explained the necessity of just proportions existing betwixt the area of the interior of the blast-furnace, the quantity of air thrown in *per minute*, and the quality of coal. The various modes of blowing, and their respective effects, deduced from strict observation, were also attended to. We have now, 3d, to adduce examples where the various changes of the atmosphere, as to heat and pressure, occasion the most sensible difference in the quantity of materials consumed, and in the quality and quantity of metal produced.

It has been already demonstrated, that the air in winter, by containing less moisture, is more proper for combustion, and more calculated to produce carbonated crude iron, than the air existing at any other season. From this superior quality the manufacturer obtains advantages, which induce him to wish for a continuance of cool air throughout the whole year. These effects are not, however, uniform; they depend greatly upon a light or heavy atmosphere. The keener and more still the air, the more rapid the combustion. During a severe frost, the descent of the materials is facilitated from  $\frac{1}{10}$  to  $\frac{1}{5}$  more than in rainy or hazy weather, and at the same time the quality of the iron is rather improved than impaired. When a change from frost to snow or rain takes place, the effects frequently become almost immediately obvious: the colour of the flame at the furnace-head is changed; the tuyre of the furnace inflames, and burns with great violence; the lava, as it flows from the notch of the dam-stone, becomes lengthened and tenacious; the form of it is changed, and the colour undergoes the most visible alterations; the iron no longer retains its complete saturation of carbon, but flows out sensibly impaired of its fluidity, and, when cold, the privation of carbon is most evident by the examination of its fracture.

When such consequences arise from the transition so frequent in winter from frost to thaw, it will be easily conceived that the change effected during the milder and warmer months must produce proportionally additional effects. The increase of temperature by taking up, and holding in solution, a much greater portion of aqueous vapour, will account for the ordinary effects which are annually observable in every work. Where these pernicious consequences approach to extremity, a solution of the phenomenon will likely be obtained by the examination of the blowing-apparatus. If air is fitted for combustion in proportion as it is free from watery solutions, we are not to expect similar results from these blast-furnaces in summer, which are blown by air from the regulating cylinder, and those blown by air from a water or air-vault. I have for years seen this fact verified, and superior quantity and quality of iron during the hot weather, obtained from a furnace excited by means of blast, from the simple regulating cylinder, with a less proportion of fuel than from furnaces whose air was expressed by means of the water or air-vault. Observations thus made, where every day the effects of the different means could be justly estimated and compared, have led me to the following conclusion: That the quality of the air, as furnished us by nature in our atmosphere, is uniformly more fit for the manufacture of crude iron to profitable account, when discharged simply by means of cylinders and pistons, than when brought into contact with moisture either in the water-vault or air-vault.

So imperfect has the quality of the summer air been found in this country for combustion, where the water-vault was used, that experiments have been made to repair the deficiency of effect by introducing steam into the furnace by means of an aperture above the tuyre. The inducing motive to this act, was a belief, that combustion was diminished in consequence of a diminution of oxygen gas during the summer; that, by introducing water upon a surface of materials ignited to whiteness, decomposition would ensue, a larger quantity of oxygen would then be presented to the fuel, and superior effects, as to combustion, obtained in this manner than hitherto

thereto witnessed. The idea was ingenious, and, in its application to the manufacture of cast iron, original; but the whole train of facts, laid down in this and former papers, as to the effects of a superabundant quantity of oxygen, was overlooked. The event proved in the most complete manner, and on a great scale, the pernicious effects of moisture. The furnace gradually became cooled where the steam entered; the heat, set free by the decomposition of the water and the disengagement of oxygen, increased to an alarming pitch a considerable way up the furnace; the quality of the iron became brittle, and as white in the fracture as silver; the introduction of the steam was still continued, the descending materials were instantly robbed of their heat to facilitate the decomposition of the water, and by-and-by the furnace closed entirely over, and the experiment ceased\*.

This experiment, performed in a furnace 18 feet high, is a complete proof that heat is disengaged from bodies while they pass from the fluid to the aërisome state. The first instant of the discharge of steam, a very considerable portion of heat would be withdrawn from the fusing materials and uniting to the water. This, in its turn, would be ignited to whiteness, and decomposed upon the metals and cokes, in a superior region of the furnace. The process continuing for several hours, the materials at the tuyre were at last so completely deprived of the caloric by the continual torrent of steam, that they lost fluidity, cooled rapidly, and at last became black. Had another aperture for steam and for air been opened above these, now entirely shut up by the consolidated materials, the same effects would have been produced; the immense quantity of caloric, disengaged by the decomposition of the ignited water, would now approach nearer to the top of the furnace, another stratum of fusing materials would again become consolidated, till in the end the whole furnace would be set fast from top to bottom. From the introduction of steam into the blast-furnace, either as such, or under a superior degree

\* The respectable and ingenious author of this experiment is among the first in the iron trade who devotes a liberal and scientific education to the improvement of this favourite branch: from his situation, talents, and opportunity, much may be expected.

of expansive force, the following important truths may be learned: That the quantity of oxygen which enters into our atmospheric compound is generally more fit for the manufacture of the superior qualities of crude iron than any mixture which may be furnished by the addition of water: that, although the decomposition of water, by furnishing a superior quantity of oxygen, and by throwing off a relative proportion of caloric, increases the effects of combustion immediately in the vicinity of this chemical analysis; yet, as the water had previously abstracted the heat necessary to its decomposition from the inferior strata, a greater quantity by no means exists in the furnace. The water, in fact, only serves as a medium to convey the heat from one particular spot, but, by attempting to fly off with it, meets decomposition, and renders up not only the abstracted heat, but that which was contained in the oxygen of its decomposition.

4th, The compression and velocity of the air discharged into the furnace, considerably affect the results of the melting operations. In the consideration of this subject, the various qualities of coals will be found to have an intimate connection with the area of the discharging-pipe and the compression of the blast. It has already been more than once observed, that a soft or mixed quality of coal is more susceptible of combustion than either the splint or clod-coal: the consequence of this is, that, unless the necessary compression of air is used, decomposition is too early accomplished, and the cokes become oxygenated by combustion in a greater ratio than is proper for the carbonation of the metal. To avoid this, the column of air ought to be discharged, in the case of soft coals being unavoidably used, under such a degree of compression, as to resist entire decomposition in the ignited passage. In that case, the iron does not so immediately come into contact with oxygen, as the decomposition is chiefly effected in the superior strata of the separating materials. Under the former circumstance, of a loose unconnected stream of air being thrown upon cokes easily combustible, the quality of the metal, with the same quantity of fuel, becomes oxygenated, the tuyre becomes fiery, and frequently emits sparks of metallic oxyd. The separating iron may

may be viewed as it oozes from the ore in small globular masses, frequently on fire, changing its state to that of air oxyd. The combination of oxygen, by altering its density, makes it subject to the re-action of the blast, which at times gives it a direction from the tuyre with considerable violence. Those parts of the iron (by far the greatest) thus oxydated, which escape not at the tuyre, mix along with the fused earths of the ores and limestone, alter their colour, and flow from the furnace more unrevived than at their first introduction. It is, however, very different, even with this inferior quality of coal, where the density of the blast is proportioned to the inflammability of the fuel. Qualities and quantities of crude iron may be produced from this, equal to those from coals reckoned of a superior nature. The metal becomes as highly saturated with carbonic principle as that made from clod or splint coal. The tuyre evinces that decomposition is effected in its proper place. The fluid masses of iron, as they become expressed from the ore, are shivered into spray, before the dense column of air, without exhibiting the least symptom of decomposition. They again unite under the level of the blast, increase in size, and sink through the fluid stratum of earths to the bottom of the furnace. This fact holds out one of the strongest proofs of the great affinity which carbon and iron mutually possess towards each other. In the case of the iron separating in an oxygenated state destitute of carbon, it immediately falls a prey to its affinity for oxygen. In the latter case, the iron, being completely carbonated, resists decomposition by the sacrifice of a very small portion of its carbon: it further proves, that the affinity of oxygen is greater to carbon than to iron; and that, before iron becomes oxydated, all the carbon is taken up.

The continuity of the particles of splint coals renders the cokes of difficult combustion, capable of withstanding a most powerful discharge of air, in quantity and in the degree of compression, without entailing effects similar to those produced with the use of softer coals: this renders the operations with splint coal less subject to casualty and to change. Carbonated iron with a proper blast is more uniformly obtained, and frequently a very superior quantity. Similar effects

effects are produced with the clod coal, but in a more eminent degree. Discharging-pipes are used four inches in the diameter, and the compression only equal to two pounds on the square inch; yet the same fatal effects are not known as in the use of soft coal, which, with such a column of air, would require the pressure to be equal to  $3\frac{1}{2}$  pounds upon the square inch at least.

5th, Upon the form and construction of the discharging-pipe effects of more considerable importance depend than is either generally allowed or even conceived. At some iron-works, no peculiar shape is adopted: if the tube is sufficient to convey the air, and the mouth of it nearly of the size wanted, the interior construction is entirely overlooked. This indifference, however, is by no means general: variously constructed pipes are used at different works, and at some places it is preferred to throw in the air from two pipes whose areas are only equal to one of the usual size.

The various shapes may, in point of the principle of their construction, be reduced to three. (See Plate V. Fig. 1, 2, 3.)

To understand properly the objectionable parts of the construction of nose-pipes, it must be recollect<sup>d</sup>, that much has been said to depend upon the blast reaching the opposite extremity of the furnace, as little impaired of the compactness and velocity of its original discharge as possible. When it is otherwise, the results in the internal operations of the furnace must be consequently altered. If the compression is diminished  $\frac{1}{2}$  or  $\frac{2}{3}$  when it reaches the opposite wall, decomposition in that portion must be effected before the air has attained its elevated situation in the furnace. It is even possible to disperse the whole column of air in such a manner that the ignited materials of the opposite side may receive little of its effects to promote combustion.

The discharging-pipe Fig. 1. is frequently used: its length is 12 inches or more; the discharging aperture 3 inches, the other end 5 inches; but this is arbitrary, depending upon the size of the adjoining pipe. From a pipe thus constructed, the air disperses or diverges too suddenly; and at a small distance from the orifice, a considerable portion of it answers but imperfectly the purposes of combustion. Part of it is speedily decomposed, and the oxygen brought into immediate

contact with the iron. The quantity of metal is reduced by the former, and the quality injured by the latter. Though long custom, by a continued use of such shaped pipes, has prevented their pernicious effects from being observed, yet they must prove in many cases detrimental to the economical distribution of air, and the manufacture of iron.

Fig. 2. represents a nose-pipe, of another construction, even more exceptionable; because the air dispersing still more suddenly, in a degree somewhat proportionate to the more sudden contraction of the pipe, a considerable quantity never enters the furnace, but, striking on the exterior wall, is thence repelled.

A discharging-pipe constructed as in Fig. 3. would obviate, in a great measure, the imperfections of the two former: the length of the tapered piece is 12 inches, of the straight pipe, 6 inches; extreme diameter as in the others, 5 inches; diameter of straight pipe, 3 inches. From such a pipe it is conceived that the blast will proceed to the greatest possible distance unimpaired in compression and velocity. So far, therefore, as the absolute force of the blast and breadth of the furnace will permit, decomposition will be prevented on the level of the pipe, and the manufacturer freed from the evils which I have above detailed, as attendant upon decomposition in that quarter.

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*IV. Communication from Mr. HENRY CLUTTERBUCK,  
Surgeon to the University Royal Dispensary, on the Cure  
of those Affections which arise from the Poison of Lead.*

*To the Editor of the Philosophical Magazine.*

SIR,

THE extensive circulation of your Magazine amongst the manufacturing classes of the community, appears to me to render it a proper vehicle for the following communication. Should you be of this opinion, your insertion of it will oblige,

Sir, your humble Servant,

H. CLUTTERBUCK.

Willesbrook, March 7, 1800.

IN

IN the year 1794 I published a small pamphlet \* containing an account of the efficacy of *mercury* in removing the effects of the poison of *lead* on the constitution of those employed in working with that metal. As the practice then recommended seems to me to have engaged less attention than its importance merits, I wish here to recapitulate, as briefly as possible, the facts then stated, and to add such further observations as my subsequent experience has suggested relative to the subject.

I hardly need state to you the great number of persons who, in the course of their occupations, are employed about this poisonous mineral; nor how large a proportion of these suffer the agony of colic, followed, in many cases, by the loss of the use of their limbs, disqualifying them, in a short time, from earning their subsistence. The white-lead manufactories, the work-shops of the plumber, the glazier, and the painter, afford too many proofs of the truth of this. The frequent inefficacy of the ordinary methods of treatment in those cases is well known. The suggestion, therefore, of a mode of relief more powerful than these, and, in recent cases, almost certain, must be allowed to be a thing of no inconsiderable moment. Such a remedy, I venture to say, will be found in *mercury*. At the time of publishing my former remarks on the subject, I had tried its powers in eight instances only, in all of which it afforded the most striking relief. The truth of this, I should observe, did not then rest on my own testimony alone, but was confirmed by that of the Physicians of the *Dispensary*, my colleagues at the time. The trials which I have since made and witnessed, though not invariably attended with success, have afforded ample proof of the powers of the remedy in question, which Dr. Bradley, now Physician to the Westminster Hospital, did not hesitate, in his letter to me on the subject, to call a *specific* in those disorders.

The affections commonly induced on the body by the poison of *lead* are, violent colic, with obstinate constipation,

\* Account of a new and successful Method of treating those Affections which arise from the Poison of Lead. Printed for *Bosey*, Broad-street, London.

relievable only by the most active purgatives, and very frequently recurring; pains resembling rheumatism, about the arms and shoulders; head-ach; cramps of the legs, and oftentimes severe fits of the gout in the extremities; palsied state of muscles of the arms and hands, taking away all power of grasping any thing, and even of lifting the hand to the mouth; and, not unfrequently, epileptic convulsions.

The remedies commonly employed for the relief of these dreadful symptoms are, purgatives of different kinds, especially *caytor oil*; volatile and stimulating medicines of various sorts; and the warm bath, particularly the *Bath waters*. These often are of signal service; but they are, likewise, often inadequate to afford relief, and the unhappy sufferer drags on a miserable existence. In a large proportion of these cases, I think I am warranted in saying, *mercury* is an effectual remedy.

*Calomel* (a mercurial preparation) has been long in use for the relief of the colic and constipation produced by *lead*; but it is as a purgative only that it has been employed, without regard to its effects on the constitution generally. The object I have here in view is, to employ mercury in such a way as to produce the ordinary effects of this mineral on the general habit, characterised by foreness of the mouth, and tendency to salivation. It does not seem very material in what way, or with what particular preparation of mercury, this is brought about; as I have employed it, in the form of ointment, externally to the affected parts, and inwardly in various preparations, without observing any material difference in the effects. For the relief of colic and obstruction of the bowels, calomel is, perhaps, the best and most commodious form; given in the quantity of a grain daily, it rarely fails, in a short time, to induce a regular action of the bowels, with the entire removal of pain. It must be observed, however, that the system, in the cases which have been described, is peculiarly susceptible of the irritation of mercury in all its forms; it is necessary, therefore, to employ it with caution, and more sparingly than in some other cases. If the disease has been of long standing, it is requisite to keep up the mercurial action for several weeks, and to renew it, from

time to time, at short intervals. Two or three months, and even a longer period, will be sometimes required for the attainment of the desired end.

I shall not disguise, that, in cases of long standing, where the muscles of the limbs are wasted and become rigid, and the joints stiff and unpliant, mercury, like all other means, will often be found ineffectual. A great obstacle to the cure, too, frequently arises from the poverty and wretchedness of the objects: ill fed, and without sufficient shelter against the inclemencies of season, the constitution is unable to sustain the debilitating action of the remedy. The effects of cold, as I have just hinted, influence materially the cure. In the winter season, the use of the limbs is much more slowly recovered than in warm weather. This leads one to expect advantage from the warm bath in such cases; and, in fact, this is one of the most powerful remedies we possess, and is calculated greatly to aid the good effects of mercury. The *Bath waters* are very successfully employed for the purpose, and the hospital there much resorted to by patients of this description.

If the advantages of the plan I have here recommended be more widely diffused, through the medium of your useful *Miscellany*, I shall be highly gratified.

I am happy to find my observations on this subject lately confirmed by a respectable foreign writer. M. Warburg, of Berlin, in a Tract on Palsy, strongly recommends the use of calomel and mercurial frictions in that species of the disease which is produced by *lead*\*.

#### V. *Observations on Spiders, and their supposed Poison.*

*By M. AMOREUX jun. M. D.*

[Concluded from Page 80.]

**I**T is well known that chickens, nightingales, and other birds eat spiders without sustaining any injury: spiders have also been prescribed as a remedy chiefly in the tympanis. All these instances, however, do not disprove the observa-

\* *De Paralyse, Auctore Jacobo Warburg, Berolinensi.*

tions

tions of those who have seen disagreeable consequences from the pricking of spiders. Lister is among this number; and Lister must be believed, because he made many observations on these insects. This author says positively, in a particular treatise, that several spiders have a venomous liquor\*. We are assured, on the other hand, by Robert Boyle †, that he never saw any venomous spiders in Ireland, notwithstanding the prejudices of the people; but, out of respect for an author who had none for others, he durst not controvert what Scaliger had advanced in regard to the spiders of Gascony, which, he says, are so venomous, that, when they are crushed with the feet, the venom penetrates the soles of the shoes.

The experiments of M. Bon, a member of the Chamber of Accounts of Languedoc, seem, however, contrary to the assertion of Scaliger. This magistrate, who endeavoured to apply to some useful purpose the threads of spiders, touched a great number of these insects, and had been frequently bit by them without experiencing any bad consequences. Hoffman, without doubt, went too far when he defied any one to prove that spiders or any other insects, taken internally, ever caused the least inconvenience to people in health. In this defiance there is, without doubt, some exaggeration. It is well known that the injury done to us by the greater part of insects arises only from their sting; but insects of a caustic nature cannot certainly be swallowed with impunity. Though there have been people who ate spiders, disagreeable consequences have been seen to arise from the bite of these insects. This depends on the kind of spider, the time, and the place. As there are poisons which have more action when introduced through the skin than when taken internally, such as that of the viper, I am inclined to think that the poison of the spider may have a contrary effect; it exercises a stronger action, perhaps, internally than on the skin. Punctures, indeed, are of little consequence; and we are told of surprising effects by

\* Araneas in ipso morsu venenum suum dimittunt, ideo mihi verisimile est, quod ab una aliquâ hac bestiâ, à me locutâ, lymphæ purissimæ, guttæ exiguae decies et amplius intra breve tempus resperias notavi; idque totus facilitavit quoties mordere voluit.

† Tentam. Physiol. p. 38.

spiders infused or bruised in wine employed with an intention of poisoning. What is related on one hand, of spider-eaters, and on the other, of those who have been poisoned by drinking wine in which spiders have been infused, seems to be contradictory: but it, however, is not so: the difference arises, no doubt, from the difference of the spiders, and the different constitution of the subjects.

It is pretended also, that spiders diffuse a noxious vapour when burnt, and that, when they burst on being applied to a flame, they spurt out a noxious liquor. I shall here relate what is said on this subject by Turner in his Treatise on the Diseases of the Skin \*. "When a young practitioner," says he, "I was sent for to visit a woman who had been accustomed, every time she went to the cellar with a candle, to burn all the spiders' webs which she could find. It happened, however, that one of these insects sold its life much dearer than the rest. Its feet having got entangled in the tallow, and its body bursting, its venom and juices were thrown out into the eyes of its persecutor, and particularly on her lips. The latter swelled up prodigiously in the night-time; one of her eyes became exceedingly inflamed, and her tongue and gums were also affected. At last these afflictions were accompanied with continual vomiting, &c. I ordered at first a small glass of Spanish wine burnt with a scruple of salt of worm-wood, and some hours after a bolus of theriac, which she afterwards threw up. I rubbed her lips with oil of scorpions and oil of rosat, &c.; I applied leeches to the temples, by which the inflammation of the eye was much diminished; and I allayed the pain by the use of a very bright mucilage of the seeds of quinces and white poppies, extracted in rose-water. But as the swelling of the lips still increased, I applied a cataplasm, made with a decoction of scordium, rue, and elder-flowers, thickened with the farina of vetches, &c." The author, however, notwithstanding his care, had not the honour of performing a cure. An old woman, as is often the case, interfered; and had all the glory, after fifteen days application of the leaves and juice of plantain, and spiders webs. Turner relates that before this accident, the patient had

\* Vol. II. p. 292. of the French edition.

told him, the smell which arose when she burnt spiders in that manner had often affected her head so much, that she thought the objects she saw turned round. She often even experienced fainting fits with cold sweats, and sometimes a slight vomiting. But notwithstanding all this, she found so much pleasure in tormenting these poor insects, that nothing could cure her of her mania till she met with the accident above mentioned. This lesion may serve as a warning to those who have the same mania, and who, besides exposing themselves to injury of the like kind, run the risk of burning their apartment, or perhaps the whole house.

The punctures made by large spiders (I here allude to those of France) are almost insensible. There is formed around the wound a livid swelling, sometimes with phlyctenes, which seem to announce a septic poison. The other symptoms, described by different authors, are so various, that, if they were united in the same subject, the poison of the spider would be the most violent of any known. It is surprising how the ancients have assigned particular symptoms to characterise the puncture of each kind of phalangium and spider. One might be induced to believe that they observed an analogy or relation between our humours and the colours of these insects : they have marked all the degrees of pain, from itching to stupor. On this subject the reader may consult Paulus Ægineta, Avicenna, Rhazes, Nicander, Grevin, &c. Afterwards a whole cloud of authors repeated that the venom of spiders, introduced into the body in any manner whatever, was followed by numbness of the part, cold of the extremities, shivering, swelling of the lower belly, paleness, involuntary shedding of tears, and an inclination to make water ; priapism in young persons, relaxation of the same member in old people, convulsions, &c.

It is very uncommon to see consequences so fatal, unless people have the misfortune to be bitten by the avicular spider of America, which destroys birds' nests; or by the black spider of Madagascar, which, according to Flacourt, occasions shivering, and cools the blood ; or, in the last place, by the *tunga*, the wolf-spider, and *nhamduguasu*, which are ferocious spiders of Brasil, mentioned by Lecluse and Margraff.

Merian

Merian has given a figure of the large hairy spider of Guava, which lives on the colibris.

Brogiani assures us, that in Etruria there is a kind of phlangium which resides in the earth, the puncture of which occasions violent symptoms; such as phrenitis, vomiting, gangrene in the wounded part, or exanthemata. Sheep also have died in consequence of being punctured by this insect. Brogiani does not here allude to the tarantula, as he treats of that insect separately. The Italian journals, some time ago, announced that a large kind of spider had occasioned great ravage in the fields of Volterra, in Tuscany. It attacked the reapers, and, by its puncture, occasioned violent pain and convulsive movements in all the limbs. Nothing of the like kind is to be apprehended in France, except in some cantons during the dog-days. An enlightened naturalist, the Chevalier de Lamanon, says, that in the month of June 1782 the drought and heat were so great in Provence, that spiders, which in general are not venomous, occasioned by their bite severe diseases, which had a great resemblance to those occasioned by the bite of the tarantula. In ordinary cases of being bit or punctured by spiders, it will be sufficient to wash the wounded part with brine, to apply theriac, and to prescribe one or two doses internally. The fresh leaves of sage, or those of the plantain, have been recommended as topics, and washing with vinegar. Recourse also may be had to volatile alkali.

## VI. *A cursory View of some of the late Discoveries in Science\**.

### MATHEMATICS.

**L**A PLACE, in his *Mecanique Celeste*, has considered the system of the world as a grand problem of mechanics, which he has endeavoured to resolve. For this reason he treats in the first book on the general principles of equilibrium and motion. He gives a rigorous demonstration of the principle

\* From the *Journal de Physique*, an. 8.

of the decomposition of forces. He then treats of the motion of a solid body, whatever be its figure; gives the conditions of the motion of fluids, and applies them to the motion of the waters of the sea and to that of the atmosphere. He then determines what ought to be the force acting on the celestial bodies to render their movements such as they are exhibited to our observation. The laws of Kepler conduct him directly to the principle of universal gravity; that is to say, that the action which the celestial bodies exercise on each other is in the direct ratio of their masses and the inverse of the square of their distances. The new illustrations which he gives are highly worthy the attention of geometers.

Fosiombroni has treated the principle of virtual forces like an able geometrician.

#### ASTRONOMY.

Herschel has published his observations on the satellites of Jupiter, in which he determines the length of their days, or their revolutions round their axes. The first turns round its axis in 1 day 18 hours 26' 6"; the second in 3 days 18 hours 17' 9"; the third in 7 days 3 hours 59' 6"; and the fourth in 16 days 18 hours 5' 1". He endeavours to determine the size of these bodies, but has not yet been able to attain to great accuracy. "We may only conclude," says he, "that the first satellite is larger than the second; that the second is the smallest of all; that the third is much larger than any of the rest; and that the fourth is nearly as large as the first."

Le Français Lalande continues with perseverance his catalogue of the stars of our hemisphere. He has already carried the number to 49,000.

Bouvard has completed a grand labour on the movements of the moon. He has calculated the eclipses mentioned by Ptolemy, and those observed by the Arabs. All these eclipses, compared with modern observations, have given him 12" 21 of correction for the synodical motion, and 8' 34" 5 for the mean anomaly. This agrees with the results which Laplace has found by calculation.

The French astronomers have at length terminated the grand operation of measuring an arc of the meridian from Dunkirk to Barcelona. They performed this labour with such precision, that no sensible error can be supposed in it, especially as their results are absolutely agreeable to those given by preceding measurements. It appears from their labour, that the quarter of the terrestrial meridian, that is to say, the arc of the meridian comprehended between the Equator and the North Pole, is = 2,561.370 modules, (they have employed this word to express a rule of platina of twelve feet, or two toises,) which make 5,122,740 toises. The metre is the ten millionth part of this quantity; that is to say, the length of the metre is  $\frac{256137}{2500000}$  parts of the module; and, by comparing this with the ancient measures, the true metre is  $443\frac{226}{1000}$  lines of the toise of Peru, (that is to say, of that which served the French academicians for measuring a degree in Peru,) the temperature of this toise being supposed to be  $18^{\circ}$  of Reaumur, or  $16\frac{1}{4}$  of the centigrade thermometer. The metre, therefore, is 3 feet  $11\frac{226}{1000}$  lines.

They have calculated also the length of the degree for the different latitudes which they measured. The following is the result:—

The degree between Dunkirk and Paris in the mean latitude of $49^{\circ} 56' 30''$ ,	modules,	toises.
is -	28538	or 57076

Between Paris and Evaux, in the mean latitude of $47^{\circ} 30' 46''$	- - -	28533 or 57066
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Between Evaux and Carcassonne, in the mean latitude of $44^{\circ} 41' 4''$	- - -	28489 or 56978
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Between Carcassonne and Montjouy, in the mean latitude of $42^{\circ} 17' 20''$	- -	28472 or 56944
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This length of the arc of the meridian is the same as that before determined by observations. The following is the account given of it by Lalande\*:

" In observing carefully with a sextant the zenith distance of the same stars at Paris and at Amiens, there has been found  $1^{\circ} 1' 13''$  of difference in all the altitudes between two points, the distance of which deduced from the preceding was 58233 toises. Nothing remains, therefore, but to make

\* See his *Astronomy*, third edition, No. 2661.

the following proportion:  $1^{\circ} 1' 13''$  is to 58233 toises as  $1^{\circ} 0' 0''$  is to a fourth term, found to be 57074 toises. This is the length of a degree of the earth between Paris and Amiens, determined by Picard. The mean latitude of this degree is  $49^{\circ} 23'$ . This length supposes the toise of the north, and the temperature of Reaumur's thermometer, 10 or  $12^{\circ}$ . This degree is reduced to 57056 with the toise of the equator now adopted."

It is to be observed, that according to these new measures the difference of the degree between Evaux and Carcassonne is much greater than it ought to be according to theory; for it differs 88 toises from that between Paris and Evaux, though there is only a difference of about three degrees of latitude, which makes nearly 32 toises *per* degree. That between Carcassonne and Mountjouy differs 34 toises, though there is only a difference of about two degrees of latitude, which makes 14 toises *per* degree; while the degrees between Dunkirk and Paris differ but 10 toises, and there are two degrees of latitude, which makes only four toises of difference *per* degree.

It is generally supposed that the degree under the equator is 56753 toises, as it has been estimated by the French academicians, and that under the polar circle, it is 57419 toises, which would make a mean difference of about seven toises between each degree. But it appears that the difference is a little greater between the degrees towards the pole, than between those towards the equator. The difference of 14 and 32 toises, which has been lately found, cannot be reconciled with general theory. This difference, therefore, must depend on some particular causes. These facts indicate either an irregularity in the terrestrial meridians, or an ellipticity in the equator and its parallels, or an irregularity in the interior of the earth, or an effect of the attraction of mountains, or a powerful action of these different causes united, or of some of them on each other; an action which has never been demonstrated in so striking a manner as by the results just given. It must be left to the ablest mathematicians to direct their attention to these facts in order that they may endeavour to explain the principles on which they depend,

and to attain, respecting the figure of the earth, a more perfect theory than any yet given. This confirms the opinion before entertained, that the figure of the earth is not a regular curve. It results from these calculations, that the flatness of the earth is a 334th part; that is to say, the axis is to a diameter at the equator as 333 to 334.

The length of the pendulum is another mean given by Nature for obtaining constant measures, because it is a consequence of gravity which cannot vary. It has been estimated for a pendulum, vibrating seconds at Paris, to be  $\frac{25+98}{100} \frac{1}{2}$  of the module, or  $\frac{993527}{1000000}$  of the metre.

The length of the metre being determined, serves to fix the weights and measures of capacity. Distilled water was assumed as the body which could be most easily procured in full purity; and Lefevre Gineau endeavoured to ascertain the weight of a kilogramme of this water taken at that temperature at which it has most density. The real kilogramme, the weight of a cubic decimetre of distilled water, taken at its maximum of density, and weighed in vacuo, or the unity of the weights, is 18827, or 2 pounds 5 gros 35 o'15 grains; that is, a little more than the Paris pint, which was supposed to weigh two pounds. According to these experiments, the cubic foot of distilled water, taken at its maximum of density, is 70 pounds 223 grains. It is 70 pounds 141 grains if we take the water at the temperature of  $\frac{3}{10}$  of a degree; and it would be 70 pounds 130 grains, if we should take the water at the temperature of melting ice. The maximum of the density of water, and therefore of its weight, is, when its temperature is at about 4 degrees. The kilogramme contains a thousand grammes, consequently the gramme is 18  $\frac{82}{1000}$  grains.

90th Comet. The nucleus of the comet, discovered by Méchain at the observatory of Paris about two o'clock in the morning on the 26th of Thermidor (August 7th), between Gemini and the Lynx, was exceedingly small, was surrounded by a light nebulosity, and had no traces of a tail. The diameter of the whole was only about a minute. It rose towards the north to about 60 degrees of declination. The elements of its orbit were as follows:—Longitude of the

descending node; 3 signs  $9^{\circ} 34'$ : place of the perihelion in the orbit,  $3^{\circ} 36'$ : inclination of the orbit,  $50^{\circ} 52' \frac{1}{2}$ : direction of its movement, retrograde: passage at the perihelion on the 21st of Fructidor, year 7, (Sept. 7, 1799,) at 4 hours 34 minutes mean time at Paris: distance of the perihelion 0.82387.—This is the tenth comet discovered by Meechain.

## LUMINOUS FLUID.

Fabbroni has examined the refractive power of various fluids, and shown that they are exceedingly different. Thus, ether has a refractive power much more considerable than oil. The former gives a focus of 60, the latter of 75.

Häüy has shown that several mineral substances have a double refraction; such as, transparent quartz, the topas, the emerald, calcareous spar, sulphat of barytes, the euclase, the idocrase, sulphat of strontian. Among the soluble and sapid salts, borat of soda (borax) and sulphated magnesia have double refraction; sulphur has double refraction; amber and the diamond have single refraction; carbonat of lead, or white lead ore, has double refraction.

Brougham, in a paper printed in the Transactions of the Royal Society, gives an account of some experiments which seem to him to prove that the doctrine of Newton respecting the refrangibility of the rays of light, is false. Prevost, of Geneva, thinks that Brougham is mistaken: he maintains the theory of Newton, and shows that the experiments opposed to it are not conclusive..

Dizé has considered the matter of heat as the cause of all luminous effects. He has made a great number of experiments to prove, that in all the terrestrial phenomena there is never light without heat. His conclusions are: 1. That heat always precedes luminous effects. 2. That light cannot be a body *sui generis*; because light does not take place but when caloric is free, and in sufficient accumulation, on which depends the force of the luminous effect produced. 3. The effect called luminous can only be a luminous property, which every molecule of free caloric possesses. 4. Caloric being a substance, the quantity of which is limited, darts itself towards the sun, which is its strongest point of attraction.

tion. 5. When the moleculæ of caloric are accumulated in that body, they are thrown off from it by the force of repulsion; and from this results the sublime harmony of attraction and repulsion, the only cause of the equilibrium of the universe.

[To be continued.]

**VII. On the Combustion of the Human Body, produced by the long and immoderate Use of Spirituous Liquors. By PIERRE-AIME LAIR.\***

**I**N natural as well as civil history there are facts presented to the meditation of the observer, which, though confirmed by the most convincing testimony, seem on the first view to be destitute of probability. Of this kind is that of people consumed by coming into contact with common fire, and of their bodies being reduced to ashes. How can we conceive that fire, in certain circumstances, can exercise so powerful an action on the human body as to produce this effect? One might be induced to give less faith to these instances of combustion as they seem to be rare. I confess that at first they appeared to me worthy of very little credit, but they are presented to the public as true by men whose veracity seems unquestionable. Bianchini, Massei, Rolli, Le Cat, Vicq-d'Azyr, and several men distinguished by their learning, have given certain testimony of the facts. Besides, is it more surprising to experience such incineration than to void saccharine urine, or to see the bones softened to such a degree as to be reduced to the state of a jelly? The effects of this combustion are certainly not more wonderful than those of the bones softened, or of the diabetes mellitus. This morbid disposition, therefore, would be one more scourge to afflict humanity; but in physics, facts being always preferable to reasoning, I shall here collect those which appear to me to bear the impression of truth; and, lest I should alter the sense, I shall quote them such as they are given in the works from which I have extracted them.

We read in the Transactions of Copenhagen, that in 1692

\* From the *Journal de Physique, Pluviose*, year 3.

a woman

a woman of the lower class, who for three years had used spirituous liquors to such excess that she would take no other nourishment, having sat down one evening on a straw chair to sleep, was consumed in the night-time, so that next morning no part of her was found but the skull and the extreme joints of the fingers; all the rest of her body, says Jacobæus, was reduced to ashes.

The following extract of the memoir of Bianchini is taken from the Annual Register for 1763:—The Countess Cornelia Bandi, of the town of Cesena, aged 62, enjoyed a good state of health. One evening, having experienced a sort of drowsiness, she retired to bed, and her maid remained with her till she fell asleep. Next morning, when the girl entered to awaken her mistress, she found nothing but the remains of her body in the most horrid condition. At the distance of four feet from the bed was a heap of ashes, in which could be distinguished the legs and arms untouched. Between the legs lay the head, the brain of which, together with half the posterior part of the cranium, and the whole chin, had been consumed: three fingers were found in the state of a coal; the rest of the body was reduced to ashes, which, when touched, left on the fingers a fat, fetid moisture. A small lamp which stood on the floor was covered with ashes, and contained no oil; the tallow of two candles was melted on a table, but the wicks still remained, and the feet of the candlesticks were covered with a certain moisture. The bed was not damaged; the bed-clothes and coverlid were raised up and thrown on one side, as is the case when a person gets up. The furniture and tapestry were covered with a moist kind of foot of the colour of ashes, which had penetrated into the drawers and dirtied the linen. This foot having been conveyed to a neighbouring kitchen, adhered to the walls and the utensils. A piece of bread in the cupboard was covered with it, and no dog would touch it. The infectious odour had been communicated to other apartments. The Annual Register states, that the Countess of Cesena was accustomed to bathe all her body in camphorated spirit of wine. Bianchini caused the details of this deplorable event to be published at the time when it took place, and no one contradicted

tradited them. It was attested also by Scipio Massei, a learned cotemporary of Bianchini, who was far from being credulous; and, in the last place, this surprising fact was confirmed to the Royal Society of London by Paul Rolli. The Annual Register mentions also two other facts of the same kind which occurred in England, one at Southampton and the other at Coventry.

An instance of the like kind is preserved in the same work\* in a letter of Mr. Wilmer, surgeon:—“ Mary Clues, aged 50, was much addicted to intoxication. Her propensity to this vice had increased after the death of her husband, which happened a year and a half before. For about a year, scarcely a day had passed in the course of which she did not drink at least half a pint of rum or aniseed-water. Her health gradually declined, and about the beginning of February she was attacked by the jaundice and confined to her bed. Though she was incapable of much action, and not in a condition to work, she still continued her old habit of drinking every day and smoking a pipe of tobacco. The bed in which she lay stood parallel to the chimney of the apartment, and at the distance from it of about three feet. On Saturday morning, the 1st of March, she fell on the floor; and her extreme weakness having prevented her from getting up, she remained in that state till some one entered and put her to bed. The following night she wished to be left alone. A woman quitted her at half after eleven, and, according to custom, shut the door and locked it. She had put on the fire two large pieces of coal, and placed a light in a candlestick on a chair at the head of her bed. At half after five in the morning a smoke was seen issuing through the window, and the door being speedily broke open, some flames which were in the room were soon extinguished. Between the bed and the chimney were found the remains of the unfortunate Clues: one leg and a thigh were still entire; but there remained nothing of the skin, the muscles, and the viscera. The bones of the cranium, the breast, the spine, and the upper extremities, were entirely calcined, and covered with a whitish efflorescence. The people were much

\* Annual Register for 1773, p. 73.

surprised

surprised that the furniture had sustained so little injury. The side of the bed which was next to the chimney had suffered the most; the wood of it was slightly burnt; but the feather-bed, the clothes, and covering, were safe. I entered the apartment about two hours after it had been opened, and observed that the walls and every thing in it were blackened; that it was filled with a very disagreeable vapour; but that nothing except the body exhibited any strong traces of fire."

This instance has great similarity to that related by Vicq-d'Azyr in the *Encyclopédie Méthodique*, under the head, Pathologic Anatomy of Man. A woman, about fifty years of age, who indulged to excess in spirituous liquors, and got drunk every day before she went to bed, was found entirely burnt, and reduced to ashes. Some of the osseous parts only were left, but the furniture of the apartment had suffered very little damage. Vicq-d'Azyr, instead of disbelieving this phenomenon, adds, that there have been many other instances of the like kind.

We find also a circumstance of this kind in a work entitled, *Acta Medica et philosophica Hasniensis*; and in the work of Henry Bohanier, entitled, *Le nouveau phosphore enflammé*. A woman at Paris, who had been accustomed, for three years, to drink spirit of wine to such a degree that she used no other liquor, was one day found entirely reduced to ashes, except the skull and extremities of the fingers.

The Transactions of the Royal Society of London present also an instance of human combustion no less extraordinary: It was mentioned at the time it happened in all the journals; it was then attested by a great number of eye-witnesses, and became the subject of many learned discussions. Three accounts of this event, by different authors, all nearly coincide. The fact is related as follows:—"Grace Pitt, the wife of a fishmonger of the parish of St. Clement, Ipswich, aged about sixty, had contracted a habit, which she continued for several years, of coming down every night from her bed-room, half dressed, to smoke a pipe. On the night of the 9th of April 1744, she got up from bed as usual. Her daughter, who slept with her, did not perceive she was absent till next morning when she awoke, soon after which she put on her clothes,

clothes, and going down to the kitchen, found her mother stretched out on the right side, with her head near the grate; the body extended on the hearth, with the legs on the floor, which was of deal, having the appearance of a log of wood, consumed by a fire without apparent flame. On beholding this spectacle, the girl ran in great haste and poured over her mother's body some water contained in two large vessels in order to extinguish the fire; while the fetid odour and smoke which exhaled from the body almost suffocated some of the neighbours who had hastened to the girl's assistance. The trunk was in some measure incinerated, and resembled a heap of coals covered with white ashes. The head, the arms, the legs, and the thigh, had also participated in the burning. This woman, it is said, had drunk a large quantity of spirituous liquor in consequence of being overjoyed to hear that one of her daughters had returned from Gibraltar. There was no fire in the grate, and the candle had burnt entirely out in the socket of the candlestick, which was close to her. Besides, there were found near the consumed body the clothes of a child and a paper screen, which had sustained no injury by the fire. The dress of this woman consisted of a cotton gown.

Le Cat, in a memoir on spontaneous burning, mentions several other instances of combustion of the human body. "Having," says he, "spent several months at Rhenis in the years 1724 and 1725, I lodged at the house of Sieur Millet, whose wife got intoxicated every day. The domestic economy of the family was managed by a pretty young girl, which I must not omit to remark, in order that all the circumstances which accompanied the fact I am about to relate, may be better understood. This woman was found consumed on the 20th of February 1725, at the distance of a foot and a half from the hearth in her kitchen. A part of the head only, with a portion of the lower extremities and a few of the vertebræ, had escaped combustion. A foot and a half of the flooring under the body had been consumed, but a kneading-trough and a powdering-tub, which were very near the body, had sustained no injury. M. Chretien, a surgeon, examined the remains of the body with every

juridical

juridical formality. Jean Millet, the husband, being interrogated by the judges who instituted an inquiry into the affair, declared, that about eight in the evening on the 19th of February he had retired to rest with his wife, who not being able to sleep, had gone into the kitchen, where he thought she was warming herself; that, having fallen asleep, he was wakened about two o'clock by an infectious odour, and that, having run to the kitchen, he found the remains of his wife in the state described in the report of the physicians and surgeons. The judges having no suspicion of the real cause of this event, prosecuted the affair with the utmost diligence. It was very unfortunate for Millet that he had a handsome servant-maid, for neither his probity nor innocence was able to save him from the suspicion of having got rid of his wife by a concerted plot, and of having arranged the rest of the circumstance in such a manner as to give it the appearance of an accident. He experienced, therefore, the whole severity of the law; and though, by an appeal to a superior and very enlightened court, which discovered the cause of the combustion, he came off victorious, he suffered so much from uneasiness of mind, that he was obliged to pass the remainder of his melancholy days in an hospital."

Le Cat relates another instance, which has a most perfect resemblance to the preceding:—"M. Boinneau, curé of Plerguer, near Dol," says he, "wrote to me the following letter, dated February 22, 1749: Allow me to communicate to you a fact which took place here about a fortnight ago. Madame de Boisecq, 80 years of age, exceedingly meagre, who had drunk nothing but spirits for several years, was sitting in her elbow-chair before the fire while her waiting-maid went out of the room for a few moments. On her return, seeing her mistress on fire, she immediately gave an alarm, and some people having come to her assistance, one of them endeavoured to extinguish the flames with his hand, but they adhered to it as if it had been dipped in brandy or oil on fire. Water was brought and thrown on the lady in abundance, yet the fire appeared more violent, and was not extinguished till the whole flesh had been consumed. Her skeleton, exceedingly black, remained entire in the chair,

which was only a little scorched ; one leg only, and the two hands, detached themselves from the rest of the bones. It is not known whether her clothes had caught fire by approaching the grate. The lady was in the same place in which she sat every day ; there was no extraordinary fire, and she had not fallen. What makes me suspect that the use of spirits might have produced this effect is, that I have been assured, that at the gate of Dinan an accident of the like kind happened to another woman under similar circumstances."

To these instances, which I have multiplied to strengthen the evidence, I shall add two other facts, of the same kind, published in the *Journal de Medicine*\*. The first took place at Aix, in Provence, and is thus related by Muraire, a surgeon :—“ In the month of February 1779, Mary Jauffret, widow of Nicholas Gravier, shoemaker, of a small size, exceedingly corpulent, and addicted to drinking, having been burnt in her apartment, M. Rocas, my colleague, who was commissioned to make a report respecting the remains of her body, found only a mass of ashes, and a few bones, calcined in such a manner that on the least pressure they were reduced to dust. The bones of the cranium, one hand, and a foot, had in part escaped the action of the fire. Near these remains stood a table untouched, and under the table a small wooden stove, the grating of which, having been long burnt, afforded an aperture, through which, it is probable, the fire that occasioned the melancholy accident had been communicated : one chair, which stood too near the flames, had the seat and fore-feet burnt. In other respects, there was no appearance of fire either in the chimney or the apartment ; so that, except the fore-part of the chair, it appears to me that no other combustible matter contributed to this speedy incineration, which was effected in the space of seven or eight hours.”

The other instance, mentioned in the *Journal de Medicine* †, took place at Caen, and is thus related by Merille, a surgeon of that city, still alive :—“ Being requested, on the 3d of June 1782, by the king’s officers, to draw up a report of the state in which I found Mademoiselle Thuars, who

\* Vol. LIX. p. 440.

† Vol. LIX. p. 140.

was said to have been burnt, I made the following observations:—The body lay with the crown of the head resting against one of the andirons, at the distance of eighteen inches from the fire; the remainder of the body was placed obliquely before the chimney, the whole being nothing but a mass of ashes. Even the most solid bones had lost their form and consistence; none of them could be distinguished except the coronal, the two parietal bones, the two lombar vertebræ, a portion of the tibia, and a part of the omoplate; and these, even, were so calcined, that they became dust by the least pressure. The right foot was found entire, and scorched at its upper junction; the left was more burnt. The day had been cold, but there was nothing in the grate except two or three bits of wood, about an inch in diameter, burnt in the middle. None of the furniture in the apartment was damaged. The chair on which Mademoiselle Thuars had been fitting, was found at the distance of a foot from her, and absolutely untouched. I must here observe, that this lady was exceedingly corpulent; that she was above sixty years of age, and much addicted to spirituous liquors; that the day even of her death she had drunk three bottles of wine and about a bottle of brandy; and that the consumption of the body had taken place in less than seven hours, though, according to appearance, nothing around the body was burnt but the clothes."

The town of Caen affords several other instances of the same kind. I have been told by many people, and particularly a physician of Argentan, named Bouffet, author of an Essay on Intermittent Fevers, that a woman of the lower class, who lived at *Place Villars*, and who was known to be much addicted to strong liquor, had been found in her house burnt. The extremities of her body only were spared, but the furniture was very little damaged.

A like unfortunate accident happened also at Caen to another old woman addicted to drinking. I was assured by those who told me the fact, that the flames which proceeded from the body could not be extinguished by water; but I think it needless to relate the particulars of this and of another similar event which took place in the same town, be-

cause, as they were not attested by a *procès-verbal*, and not having been communicated by professional men, they do not inspire the same confidence.

This collection of instances is supported, therefore, by all those authentic proofs which can be required to form human testimony; for, while we admit the prudent doubt of Descartes, we ought to reject the universal doubt of the Pyrrhonists. The multiplicity and uniformity even of these facts, which occurred in different places, and were attested by so many enlightened men, carry with them conviction; they have such a relation to each other that we are inclined to ascribe them to the same cause.

1. The persons who experienced the effects of this combustion had for a long time made an immoderate use of spirituous liquors.

2. The combustion took place only in women.
3. These women were far advanced in life.
4. Their bodies did not take fire spontaneously, but were burnt by accident.

5. The extremities, such as the feet and the hands, were generally spared by the fire.

6. Water sometimes, instead of extinguishing the flames which proceeded from the parts on fire, gave them more activity.

7. The fire did very little damage, and often even spared the combustible objects which were in contact with the human body at the moment when it was burning.

8. The combustion of these bodies left as a residuum fat foetid ashes, with an unctuous, stinking, and very penetrating foot.

Let us now enter into an examination of these eight general observations.

The first idea which occurs on reading the numerous instances of human combustion above related is, that those who fell victims to those fatal accidents were almost all addicted to spirituous liquors. The woman mentioned in the Transactions of Copenhagen had for three years made such an immoderate use of them that she would take no other nourishment. Mary Clues, for a year before the accident happened, had scarcely been a single day without drinking half a pint

of rum or of aniseed-water. The wife of Millet had been continually intoxicated; Madam de Boiseon for several years had drunk nothing but spirits; Mary Jauffret was much addicted to drinking; and Mademoiselle Thuars, and the other women of Caen, were equally fond of strong liquors.

Such excess, in regard to the use of spirituous liquors, must have had a powerful action on the bodies of the persons to whom I allude. All their fluids and solids must have experienced its fatal influence; for the property of the absorbing vessels, which is so active in the human body, seems on this occasion to have acted a distinguished part. It has been observed that the urine of great drinkers is generally aqueous and limpid. It appears, that in drunkards who make an immoderate use of spirituous liquors, the aqueous part of their drink is discharged by the urinary passage, while the alcoholic, almost like the volatile part of aromatic substances, not being subjected to an entire decomposition, is absorbed into every part of their bodies.

I shall now proceed to the second general observation, that the combustion took place only in women.

I will not pretend to assert that men are not liable to combustion in the same manner, but I have never yet been able to find one well certified instance of such an event; and as we cannot proceed with any certainty but on the authority of facts, I think this singularity so surprising as to give rise to a few reflections. Perhaps when the cause is examined, it will appear perfectly natural. The female body is in general more delicate than that of the other sex. The system of their solids is more relaxed; their fibres are more fragile and of a weaker structure, and therefore their texture more easily hurt. Their mode of life also contributes to increase the weakness of their organization. Women, abandoned in general to a sedentary life, charged with the care of the internal domestic economy, and often shut up in close apartments, where they are condemned to spend whole days without taking any exercise, are more subject than men to become corpulent. The texture of the soft parts in female bodies being more spongy, absorption ought to be freer; and as their

whole

whole bodies imbibe spirituous liquors with more ease, they ought to experience more readily the impression of fire. Hence that combustion, the melancholy instances of which seem to be furnished by women alone ; and it is owing merely to the want of a certain concurrence of circumstances and of physical causes, that these events, though less rare than is supposed, do not become more common.

The second general observation serves to explain the third ; I mean, that the combustion took place only in women far advanced in life. The Countess of Cesena was sixty-two years of age ; Mary Clues, fifty-two ; Grace Pitt, sixty ; Madame de Boiseon, eighty ; and Mademoiselle Thuars more than sixty. These examples prove that combustion is more frequent among old women. Young persons, distracted by other passions, are not much addicted to drinking ; but when love, departing along with youth, leaves a vacuum in the mind, if its place be not supplied by ambition or interest, a taste for gaming, or religious fervor, it generally falls a prey to intoxication. This passion still increases as the others diminish, especially in women, who can indulge it without restraint. Wilmer, therefore, observes, " that the propensity of Mary Clues to this vice had always increased after the death of her husband, which happened about a year before :" almost all the other women of whom I have spoken, being equally unconfined in regard to their actions, could gratify their attachment to spirituous liquors without opposition.

It may have been observed that the obesity of women, as they advance in life, renders them more sedentary ; and if, as has been remarked by Baumes\*, a sedentary life over-charges the body with hydrogen, this effect must be still more sensible among old women. Dancing and walking, which form salutary recreation for young persons, are at a certain age interdicted as much by nature as by prejudice. It needs therefore excite no astonishment that old women, who are in general more corpulent and more addicted to drinking, and who are often motionless like inanimate

\* *Essai du Système Chimique de la Science de l'Homme.*

*masses,*

masses, during the moment of intoxication, should experience the effects of combustion.

Perhaps we have no occasion to go very far to search for the cause of these combustions. The fire of the wooden stove, the chimney, or of the candle, might have been communicated to the clothes, and might have in this manner burnt the persons above mentioned, on account of the peculiar disposition of their bodies. Maffei observes that the Countess of Cesena was accustomed to bathe her whole body with spirit of wine. The vicinity of the candle and lamp, which were found near the remains of her body, occasioned, without doubt, the combustion. This accident reminds us of that which happened to Charles II. king of Navarre. This prince, being addicted to drunkenness and excesses of every kind, had caused himself to be wrapped up in cloths dipped in spirits, in order to revive the natural heat of his body which had been weakened by debauchery; but the cloths caught fire while his attendants were fastening them, and he perished a victim to his imprudence.

Besides accidental combustion, it remains for us to examine whether spontaneous combustion of the human body can take place, as asserted by Le Cat. Spontaneous combustion is the burning of the human body without the contact of any substance in a state of ignition. Nature, indeed, affords several instances of spontaneous combustion in the mineral and vegetable kingdoms. The decomposition of pyrites, and the subterranean processes which are carried on in volcanoes, afford proofs of it. Coal-mines may readily take fire spontaneously; and this has been found to be the case with heaps of coals deposited in close places. It is by a fermentation of this kind that dunghills sometimes become hot, and take fire. This may serve also to explain why trusses of hay, carried home during moist weather, and piled up on each other, sometimes take fire. But, can spontaneous combustion take place in the human body? If some authors are to be credited \*, very violent combustion may be produced in our bodies by nature and by artificial processes. Sturmius † says that in the northern countries flames often burst from

\* German Ephemerides, Observ. 77.

† Ibid. Tenth year, p. 55.  
the

the stomach of persons in a state of intoxication. Three noblemen of Courland having laid a bet which of them could drink most spirits, two of them died in consequence of suffocation by the flames which issued with great violence from their stomachs. We are told by Thomas Bartholin \*, on the authority of Vorstius, that a soldier, who had drunk two glasses of spirits, died after an eruption of flames from his mouth. In his third century Bartholin mentions another accident of the same kind after a drinking-match of strong liquor.

It now remains to decide, from these instances, respecting the accidental or spontaneous causes which produce combustion. Nature, by assuming a thousand different forms, seems at first as if desirous to elude our observation; but, on mature reflection, if it be found easy to prove accidental combustion, spontaneous combustion appears altogether improbable; for, even admitting the instances of people suffocated by flames which issued from their mouths, this is still far from the combustion of the whole body. There is a great difference between this semi-combustion and spontaneous combustion so complete as to reduce the body to ashes, as in the cases above mentioned. As the human body has never been seen to experience total combustion, these assertions seem rather the productions of a fervid imagination than of real observation; and it too often happens that Nature in her mode of action does not adopt our manner of seeing.

I shall not extend further these observations on the combustion of the human body, as I flatter myself that after this examination every person must be struck with the relation which exists between the cause of this phenomenon and the effects that ensue. A system embellished with imaginary charms is often seducing, but it never presents a perfect whole. We have seen facts justify reasoning, and reasoning serve afterwards to explain facts. The combustion of the human body, which on the first view appears to have in it something of the marvellous, when explained, exhibits nothing but the utmost simplicity: so true it is, that the wonderful is often produced by effects which, as they rarely strike

\* First century.

our eyes, permit our minds so much the less to discover their real cause.

Some people, however, may ascribe to the wickedness of mankind what we ascribe to accident. It may be said, that assassins, after putting to death their unfortunate victims, rubbed over their bodies with combustible substances, by which they were consumed. But even if such an idea should ever be conceived, it would be impossible to carry it into execution. Formerly, when criminals were condemned to the flames, what a quantity of combustible substances was necessary to burn their bodies! A baker's boy, named Renaud, being condemned to be burnt a few years ago at Caen, two large cart-loads of faggots were required to consume the body, and at the end of more than ten hours some remains of the bones were still to be seen. What proves that the combustion in the before-mentioned instances was not artificial is, that people often arrived at the moment when it had taken place, and that the body was found in its natural state. People entered the house of Madame Boiseon at the time when her body was on fire, and all the neighbours saw it. Besides, the people of whom I have spoken were almost all of the lowest class, and not much calculated to give rise to the commission of such a crime. The woman mentioned in the Transactions of Copenhagen was of the poorest condition; Grace Pitt was the wife of a fishmonger; Mary Jauffret that of a shoemaker; and two other women, who resided at Caen, belonged to the lowest order of society. It is incontestable, then, that in the instances I have adduced the combustion was always accidental and never intentional.

It may be seen that a knowledge of the causes of this phenomenon is no less interesting to criminal justice than to natural history, for unjust suspicions may sometimes fall on an innocent man. Who will not shudder on recollecting the case of the unfortunate inhabitant of Rheims, who, after having lost his wife by the effect of combustion, was in danger of perishing himself on the scaffold, condemned unjustly by an ignorant tribunal!

I shall consider myself happy if this picture of the fatal effects of intoxication makes an impression on those addicted.

to this vice, and particularly on women, who most frequently become the victims of it. Perhaps the frightful details of so horrid an evil as that of combustion will reclaim drunkards from this horrid practice. Plutarch relates, that at Sparta children were deterred from drunkenness by exhibiting to them the spectacle of intoxicated slaves, who, by their hideous contortions, filled the minds of these young spectators with so much contempt that they never afterwards got drunk. This state of drunkenness, however, was only transitory. How much more horrid it appears in those unfortunate victims consumed by the flames and reduced to ashes! May men never forget that the vine sometimes produces very bitter fruit—disease, pain, repentance, and death!

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VIII. *Meteorological Axioms, by L. COTTE; or the general Result of his own and foreign Meteorological Observations during the course of Thirty Years* \*.

**O**UR meteorological observations are as old as the establishment of the Academy of Sciences in the year 1666, and have never yet been interrupted. The most celebrated academicians, such as a Sidileau, a de la Hire, a Maraldi, a Cassini, a Fouchy, a Chappe, &c. have contributed towards them; and several members, such as Morin, Duhamel, Maloivin, Meslier, &c. paid attention to the same object without making themselves much known. The correspondents of the Academy also frequently communicated to it their meteorological observations. All the learned societies in Europe comprehend meteorology in the list of their labours, and particularly the Royal Society of London, the Academies of Berlin, Stockholm, Petersburg, &c. but, above all, the Medical Societies at Paris and the Hague, and the Meteorologic Society at Manheim. These three learned bodies have therefore the most extensive correspondence.

I have communicated to the public the result of the observations made by all these societies as well as of my own

\* From *Nues Journal der Physik*, by Professor Gren, Vol. III. part 5.  
during

during the course of thirty years, partly in my Treatise and Memoirs on Meteorology, and partly in the History of the Medical Society, the Collection des Savans étrangers, the Journaux des Savans, de Physique, de France, &c. I endeavoured to neglect nothing that had any relation to meteorology, and I flatter myself that I have given the result of every thing that has been published for a hundred years on this branch of science. But how tedious is its progress! From this astonishing collection of observations I have as yet been able to deduce only a very small number of physical truths, which I here lay before the public under the title of Meteorological Axioms. They are not drawn from the whole mass of the before-mentioned observations, made for a very long period, and in a careless manner, and with very imperfect instruments, but from those of the last thirty or forty years. They are as follow:—

## I.

*Of the Barometer.*

1. The greatest changes of the barometer commonly take place, during clear weather, with a north wind; and the small risings during cloudy, rainy, or windy weather, with a south, or nearly south, wind.
2. The state of the mercury changes more in the winter than the summer months; so that its greatest rising and falling take place in winter; but its mean elevation is greater in summer than in winter.
3. The changes of the state of the barometer are nearly null at the equator, and become greater the more one removes from it towards the poles.
4. They are more considerable in valleys than on mountains.
5. The more variable the wind, the more changeable the state of the barometer.
6. It is lower at midnight and noon than at other periods of the day: its greatest daily height is towards evening.
7. Between ten at night and two in the morning, and also in the day, the rising and falling of the mercury are less: the contrary is the case between six and ten in the morning and evening.

8. Between two and six in the morning and evening it rises as often as it falls; but in such a manner that it oftener rises about that time in the winter months, and falls oftener in the summer months.

9. The oscillations are less in summer, greater in winter, and very great at the equinoxes.

10. They are greater also in the day-time than during the night.

11. The higher the sun rises above the horizon, the less are the oscillations; they increase as he approaches the western side of the horizon, and are exceedingly great when he comes opposite to the eastern part of the horizon.

12. They are, to a certain degree, independent of the changes of temperature.

13. The mercury generally rises between the new and the full moon, and falls between the latter and the new moon.

14. It rises more in the apogeeum than the perigeum: it usually rises between the northern lunistice and the southern, and falls between the southern lunistice and the northern.

15. In general, a comparison of the variations of the mercury with the positions of the moon gives nothing certain: the results of Nos. 13 and 14 are the most constant.

16. In our neighbourhood the barometer never continues twenty-four hours without changing.

17. The barometers in the western districts rise or fall sooner than those in the more eastern.

18. When the sun passes the meridian the mercury if falling continues to fall, and its fall is often hastened.

19. When the mercury at the same period is rising, it falls, remains stationary, or rises more slowly.

20. When the mercury, under the same circumstances, is stationary, it falls; unless, before or after it becomes stationary, it has been in the act of rising.

21. The above changes commonly take place between eleven in the morning and one in the afternoon, but oftener before than after noon.

22. Before high tides there is almost always a great fall of the mercury; this takes place oftener at the full than the new moon.

## II.

*Of the Thermometer.*

1. The extreme degrees of heat are almost every where the same: this, however, is not the case in regard to the extreme degrees of cold.
2. The thermometer rises to its extreme height oftener in the temperate zones than in the torrid zone.
3. It changes very little between the tropics; its variations, like those of the barometer, are greater the more one proceeds from the equator towards the poles.
4. It rises higher in the plains than on mountains.
5. It does not fall so much in the neighbourhood of the sea as in inland parts.
6. The wind has no influence on its motions.
7. Moisture has a peculiar influence on it, if followed by a wind which disperses it.
8. The greatest heat, and the greatest cold, take place about six weeks after the northern or southern solstice.
9. The thermometer changes more in summer than in winter.
10. The coldest period of the day is before sun-rise.
11. The greatest heat in the sun and the shade seldom takes place on the same day.
12. The heat decreases with far more rapidity from September and October, than it increased from July to September.
13. It is not true, that a very cold winter is the prognostic of a very hot summer.

## III.

*Of the Wind.*

1. The winds between the tropics are regular and periodical.
2. The more one removes from the tropics, the more changeable they are found.
3. The winds are more changeable in winter than in summer, and towards the equinoxes than at any other time.
4. It is not true, that the wind which blows about the time

time of the equinoxes will be the prevailing wind during the next six months.

5. A fresh breeze always springs up before sun-rise, especially in summer.

6. In the neighbourhood of the sea there is a periodical land and a sea breeze.

7. Violent winds are more prevalent in the neighbourhood of mountains than in the open plains.

#### IV.

##### *Of Rain and Evaporation.*

1. Rain is more frequent in winter than in summer, but more abundant in summer than in winter.

2. It is also more abundant, but less common, in southern countries, than in those where the temperature is cold and moderate.

3. The increase and decrease of rivers are not always in proportion to the quantity of the rain which falls.

4. The quantity of rain is greater in low than in high districts, and still more so in the neighbourhood of forests and mountains.

5. The quantity of evaporation generally exceeds that of the rain.

6. The greater the heat, the stronger the evaporation.

7. It is greater also while the wind blows from the northern regions, than when it comes from the southern.

8. In the last place, it is greater during dry and cold, than during moist and warm, weather.

9. The greatest drought indicated by the hygrometer takes place in April.

#### V.

##### *Atmospheric Electricity.*

1. Electricity manifests itself oftener without storms than with them.

2. It is occasioned more frequently by dry than by rainy clouds.

3. It is oftener positive than negative, particularly when occasioned by stationary clouds, because these, without doubt, are

are at such a great distance, that the electricity which rises from the earth cannot reach them: in the opposite case it is exceedingly variable.

4. The atmosphere exhibits signs of electricity at all times; at every hour of the day and the night.

## VI.

### *The Magnetic Needle.*

1. The greatest declination of the needle from the north towards the west takes place about two in the afternoon, and the greatest approximation of it towards the north, about eight in the morning; so that, from the last-mentioned hour till about two in the afternoon, it endeavours to remove from the north, and between two in the afternoon and the next morning to approach it.

2. The annual progress of the magnetic needle is as follows:—Between January and March it removes from the north; between March and May it approaches it; in June it is stationary; in July it removes from it; in August, September, and October, it approaches it; its declination in October is the same as in May; in November and December it removes from the north: its greatest western declination is at the vernal equinox, and its greatest approximation to the north at the autumnal equinox.

3. The declination of the magnetic needle is different according to the latitude: among us it has always increased since 1666: before that period it was easterly.

4. Before volcanic eruptions and earthquakes, the magnetic needle is often subject to very extraordinary movements.

5. The magnetic needle is agitated before and after the appearance of the northern lights: its declination on these occasions is about noon greater than usual.

6. The greater or less appearance of these northern lights is variable: some years this phenomenon is very frequent, in others uncommon. For two or three years they have occurred very seldom.

7. The northern lights are more frequent about the time of the equinoxes than at other periods of the year.

8. This phenomenon is almost constant during the long winter in the polar regions, and is the more uncommon the nearer the equator.

9. Southern lights have been observed also in the regions near the south pole.

10. The northern lights are often accompanied with lightning, and a noise like that of electricity; while the lightning proceeds partly from the middle of the northern lights, and partly from the neighbouring clouds.

## VII.

### *The Lunar Period of Nineteen Years.*

It appears that the general temperature of a year returns every nineteen years; an epoch when the phases and positions of the moon in regard to the earth are again the same.

I might add more results, but I shall confine myself to those found most constant by observation, and conclude with wishing, that the zeal of observers may contribute to confirm more and more the certainty of these Axioms, or to discover new ones.

### *IX. On the Decomposition of Azotic into Hydrogen and Oxygen Gas, by M. GIRTANNER, and on the radical of the Muriatic Acid. A Letter from Van Mons, of Brussels, to Delamtherie \*.*

**I** TAKE the earliest opportunity of informing you, that Girtanner has decomposed azot, and reduced it to hydrogen and oxygen, in the proportion of 0.93 of the former and 0.07 of the latter. From this it seems to follow, that azot, ammonia, water, atmospheric air, &c. are compounds of these two principles in varied proportions. In analysing air we do not separate but compound the azotic gas by subtracting a part of oxygen from the hydro-oxygen fluid, which constitutes that air. This is, perhaps, the reason why combustion is more lively in pure oxygen gas, or oxygen gas not

\* From *Journal de Physique*, an. 8.

engaged

engaged in a combination with hydrogen. Argil is the substance which best decomposes atmospheric air, and so compounds azot; and this agrees pretty well with the experiments of Humboldt. This property of argil explains the necessity of its presence in artificial nitre-beds, and gives us reason to think that Wicgleb and Wurzer are not altogether deceived when they think of converting aqueous vapour into azotic gas. You must have remarked in my experiments on this conversion, that I could not account properly for the large quantity of gas which I frequently happened to collect.

Stormy rains may be means employed by Nature to free atmospheric air from that excess of oxygen continually flowing into it from plants, by combining into water a part of the two gases of which it is composed. This much is certain, that the uniform mixture of two fluids of densities so different as those of azotic and oxygen gas, has always led me to suspect an union of these two gases.

In a word, if the discovery of Girtanner shall be confirmed it will enable us to account for the almost total disappearance of azot during the decomposition of nitre by fire.

M. Girtanner persists in maintaining, that hydrogen is the radical of the muriatic acid, but this hydrogenic acid contains less oxygen than water. The experiments which I opposed to my friend \* all tend either to oxygenate that liquid or to de-oxygenate the acid. I followed an opposite course to Girtanner, but which was pointed out to me by himself, who at that time considered the muriatic acid as oxygenated water.

Trommsdorff was not wrong when he informed me †, that there would perhaps be more hope of discovering the radicals of undecomposed acids, by endeavouring rather to oxygenate than to de-oxygenate these substances.

I am not yet acquainted with the experiments of M. Girtanner, but I have already made a mixture of hydrogen gas and oxygen gas, in the proportion mentioned, without obtaining azotic gas. J. B. VAN MONS.

\* Mémoires de l'Institut National, Vol. I. p. 36 and 44.

† Annales de Chimie, Vol. XXXII.

X. A Botanical Description of *Urceola Elastica*, or *Caout-chouc* Vine of Sumatra and Pullo-pinang; with an Account of the Properties of its inspissated Juice, compared with those of the American Caout-chouc. By WILLIAM ROXBURGH, M. D. \*

**F**OR the discovery of this useful vine, we are, I believe, indebted to Mr. Howison, late surgeon at Pullo-pinang; but it would appear he had no opportunity of determining its botanical character. To Doctor Charles Campbell, of Fort Marlborough, we owe the gratification arising from a knowledge thereof.

About twelve months ago I received from that gentleman, by means of Mr. Fleming, very complete specimens, in full foliage, flower, and fruit. From these I was enabled to reduce it to its class and order in the Linnæan system. It forms a new genus in the class *Pentandria*, and order *Monogynia*, and comes in immediately after *Tabernæmontana*, consequently belongs to the thirtieth natural order, or class called *Contortæ* by Linnæus in his natural method of classification or arrangement. One of the qualities of the plants of this order is, their yielding, on being cut, a juice which is generally milky, and for the most part deemed of a poisonous nature.

The generic name *Urceola*, which I have given to this plant, is from the structure of the corol, and the specific name from the quality of its thickened juice.

So far as I can find, it does not appear that ever this vine has been taken notice of by any European till now. I have carefully looked over the *Hortus Malabaricus*, Rumphius's *Herbarium Amboinense*, &c. &c. figures of Indian plants, without being able to find any one that can with any degree of certainty be referred to. A substance of the same nature, and probably the very same, was discovered in the island of Mauritius by M. Poivre, and from thence sent to France; but, so far as I know, we are still ignorant of the plant that yields it.

\* From the *Asiatic Researches*, Vol. V.

The impropriety of giving to *Caout-chouc* the term gum, resin, or gum-resin, every one seems sensible of, as it possesses qualities totally different from all such substances as are usually arranged under those generic names; yet it still continues, by most authors I have met with, to be denominated elastic resin or elastic gum. Some term it simply *Caout-chouc*, which I wish may be considered as the generic name of all such concrete vegetable juices (mentioned in this memoir) as possess elasticity, inflammability, and are soluble in the essential oils, without the assistance of heat.

In a mere definition it would be improper to state what qualities the object does not possess; consequently, it must be understood that this substance is not soluble in the menstruums which usually dissolve resins and gums.

East-India *Caout-chouc* would be a very proper specific name for that of *Urceola elastica*, were there not other trees which yield juices so similar as to come under the same generic character; but as this is really the case, I will apply the name of the tree which yields it for a specific one. E. G. *Caout-chouc* of *Urceola Elastica*, *Caout-chouc* of *Ficus Indica*, *Caout-chouc* of *Artocarpus integrifolia*, &c. &c.

### Description of the Plant Urceola.

#### PENTANDRIA MONOGYNIA.

*Gen. Char.* Calyx beneath five-toothed; corol one-petaled, pitcher-shaped, with its contracted mouth five-toothed; nectary entire, surrounding the germs; follicles two, round, drupaceous; seeds numerous, immersed in pulp.

#### URCEOLA ELASTICA.

Shrubby, twining, leaves opposite, oblong, panicles terminal; is a native of Sumatra, Pullo-pinang, &c. Malay countries.

Stem, woody, climbing over trees, &c. to a very great extent, young shoots twining, and a little hairy, bark of the old woody parts thick, dark-coloured, considerably uneven, a little scabrous, on which I found several species of moss, particularly large patches of lichen: the wood is white, light, and porous.

Leaves, opposite, short-petioled, horizontal, ovate, oblong,  
X 2 pointed,

pointed, entire, a little pubescent, with a few scattered white hairs on the under-side.

*Stipules*, none.

*Panicles*, terminal, brachiate, very ramus.

*Flowers*, numerous, minute, of a dull greenish colour, and hairy on the outside.

*Bracts*, lanceolate, one at each division and subdivision of the panicle.

*Calyx*, perianth, one-leaved, five-toothed, permanent.

*Corol*, one-petaled, pitcher-shaped, hairy, mouth much contracted, five-toothed, divisions erect, acute, nectary entire, cylindric, embracing the lower two-thirds of the germs.

*Stamens*, filaments five, very short from the base of the corol. Anthers arrow-shaped, converging, bearing their pollen in two grooves on the inside near the apex; between these grooves and the insertions of the filaments they are covered with white soft hairs.

*Pistil*, germs two; above the nectary they are very hairy round the margins of their truncated tops. Style single, shorter than the stamens. Stigma ovate, with a circular band, dividing it into two portions of different colours.

*Per.* Follicles two, round, laterally compressed into the shape of a turnip, wrinkled, leathery, about three inches in their greatest diameters; one-celled, two-valved.

Seeds, very numerous, reniform, immersed in firm fleshy pulp.

*Explanation of the Figures.* (Plate IV.)

1. A branchlet in flower, natural size.
2. A flower magnified.
3. The same laid open, which exposes to view the situation of the stamens inserted into the bottom of the corol, the nectarium surrounding the lower half of the two germs, their upper half with hairy margins, the style and ovate partly-coloured; stigma appearing above the nectary.
4. Outside of one of the stamens, } much magnified.
5. Inside of the same, } magnified.
6. The nectarium laid open, exposing to view the whole of the pistil.
7. The two seed-vessels (called by Linnaeus *follicles*), natural

natural size; half of one of them is removed, to show the seed immersed in pulp. A portion thereof is also cut away, which more clearly shows the situation and shape of the seed.

From wounds made in the bark of this plant there oozes a milky fluid, which, on exposure to the open air, separates into an elastic coagulum and watery liquid, apparently of no use after the separation takes place. This coagulum is not only like the American *Caoutchouc*, or Indian rubber, but possesses the same properties, as will be seen from the following experiments and observations made on some which had been extracted from the vine about five months ago. A ball of it now before me, is, to my sense, totally void of sinew even when cut into, is very firm, nearly spherical, measures nine and a half inches in circumference, and weighs seven ounces and a quarter; its colour on the outside is that of American *Caoutchouc* where fresh cut into, of a light-brown colour, till the action of the air darkens it: throughout there are numerous small cells filled with a portion of light-brown watery liquid above mentioned. This ball, in simply falling from a height of fifteen feet, rebounds about ten or twelve times; the first is from five to seven feet high, the succeeding ones of course lessening by gradation.

This substance is not now soluble in the above-mentioned liquid contained in its cells, although so intimately blended therewith, when first drawn from the plant, as to render it so thin as to be readily applied to the various purposes to which it is so well adapted when in a fluid state.

From what has been said, it will be evident that this *Caoutchouc* possesses a considerable share of solidity and elasticity in an eminent degree. I compared the last quality with that of American *Caoutchouc*, by taking small slips of each, and extending them till they broke; that of *Urecola* was found capable of bearing a much greater degree of extension (and contraction) than the American: however, this may be owing to the time the respective substances have been drawn from their plants.

The *Urecola Caoutchouc* rubs out the marks of a black-lead pencil as readily as the American, and is evidently the substance of which the Chinese make their elastic rings.

It contains much combustible matter, burning entirely away, with a clear flame, emitting a considerable deal of dark-coloured smoke, which readily condenses into a large proportion of exceeding fine soot, or lamp-black; at the same time it gives but little smell, and that not disagreeable: the combustion is often so rapid as to cause drops of a black liquid, very like tar, to fall from the burning mass; this is equally inflammable with the rest, and continues when cold in its semi-fluid state, but totally void of elasticity: in America, the *Caout-chouc* is used for torches; ours appears to be equally fit for that purpose. Exposed in a silver spoon to a heat about equal to that which melts lead or tin, it is reduced into a thick, black, inflammable liquid, such as drops from it during combustion, and is equally deprived of its elastic powers, consequently rendered unsit for those purposes for which its original elasticity rendered it so proper.

It is insoluble in spirits of wine, nor has water any more effect on it, except when assailed by heat, and then it is only softened by it.

Sulphuric acid reduced it into a black, brittle, charcoal-like substance, beginning at the surface of the *Caout-chouc*, and if the pieces are not very thin or small, it requires some days to penetrate to their centre; during the process the acid is rendered very dark-coloured, almost black. If the sulphuric acid is previously diluted with only an equal quantity of water, it does not then appear to have any effect on this substance, nor is the colour of the liquid changed thereby.

Nitric acid reduced it in twelve hours to a soft, yellow, unelastic mass, while the acid is rendered yellow; at the end of two days, the *Caout-chouc* had acquired some degree of friability and hardness. The same experiment made on American *Caout-chouc* was attended with similar effects. Muriatic acid had no effect on it.

Sulphuric æther only softened it, and rendered the different minute portions it was cut into easily united, and without any seeming diminution of elasticity.

Nitric æther I did not find a better menstruum than the vitriolic; consequently, if the æther I employed was pure, of which I have some doubt, this substance must differ essentially

fentially from that of America, which Berniard reports to be soluble in nitric æther.

Where this substance can be had in a fluid state, there is no necessity for dissolving or softening it, to render it applicable to the various uses for which it may be required; but where the dry *Caout-chouc* is only procurable, sulphuric æther promises to be an useful medium, by which it may be rendered so soft as to be readily formed into a variety of shapes.

Like American *Caout-chouc*, it is soluble in the essential oil of turpentine; and I find it equally so in Cajeput oil, an essential oil, said to be obtained from the leaves of *Melaleuca Leucadendron*. Both solutions appear perfect, thick, and very glutinous. Spirits of wine, added to the solution in Cajeput oil, soon united with the oil, and left the *Caout-chouc* floating on the mixture in a soft semi-fluid state, which, on being washed in the same liquor, and exposed to the air, became as firm as before it was dissolved, and retained its elastic powers perfectly, while in the intermediate states, between semi-fluid and firm, it could be drawn out into long transparent threads, resembling, in the polish of their surface, the fibres of the tendons of animals; when they broke, the elasticity was so great, that each end instantaneously returned to its respective mass. Through all these stages, the least pressure with the finger and thumb united different portions as perfectly as if they never had been separated, and without any clamminess or sticking to the fingers, which renders most of the solutions of *Caout-chouc* so very unsit for the purposes for which they are required. A piece of catgut, covered with the half-inspissated solution, and rolled between two smooth surfaces, soon acquired a polish and consistence very proper for bougies. Cajeput oil I also found a good menstruum for American *Caout-chouc*, and was as readily separated, by the addition of a little spirit of wine or rum, as the other, and appears equally fit for use, as I covered a piece of catgut with the washed solution as perfectly as with that of *Urceola*. The only difference I could observe, was a little more adhesive-ness, from its not drying so quickly; the oil of turpentine had greater attraction for the *Caout-chouc* than for the spirits of

wine, consequently remained obstinately united to the former, which prevented its being brought into that state of firmness fit for handling, which it acquired when Cajeput oil was the menstruum.

The Cajeput solution employed as a varnish did not dry, but remained moist and clammy, whereas the turpentine solution dried pretty fast.

Expressed oil of olives and linseed proved imperfect menstruums while cold, as the *Caout-chouc*, in several days, was only rendered soft, and the oils viscid, but with a degree of heat equal to that which melts tin, continued for about twenty-five minutes, it was perfectly dissolved, but the solution remained thin, and void of elasticity. I also found it soluble in wax and in butter in the same degree of heat; but still these solutions were without elasticity, or any appearance of being useful.

I shall now conclude what I have to offer on the *Caout-chouc*, or *Urceola elastica*, with observing, that some philosophers of eminence have entertained doubts of the American *Caout-chouc* being a simple vegetable substance, and suspect it to be an artificial production; an idea which I hope the above detailed experiments will help to eradicate, and consequently, to restore the histories of that substance by M. De la Condamine and others, to that degree of credit to which they seem justly entitled; in support of which it may be further observed, that, besides *Urceola elastica*, there are many other trees, natives of the torrid zone, that yield a milky juice, possessing qualities nearly of the same nature, as *artocarpus integrifolia* (common-jack tree), *ficus religiosus et Indica*, *Hippomane glandulosa*, *Cecropia peltata*, &c.

The *Caout-chouc*, or *Ficus religiosa*, the Hindus consider the most tenacious vegetable juice they are acquainted with; from it their best bird-lime is prepared. I have examined its qualities, as well as those of *ficus Indica* and *artocarpus integrifolia*, by experiments similar to those above related, and found them triflingly elastic when compared with the American and Urceola *Caout-choucs*, but infinitely more viscid than either; they are also inflammable, though in a less degree, and show nearly the same phenomena when immersed

immered in the mineral acids, solution of caustic alkali, alkohol, fat and essential oils; but the solution in Cajeput oil could not be separated by spirits of wine, and collected again, like the solutions of the Urceola and American *Cacuchoues*.

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*XI. Account of some Improvements introduced by the Scotch Distillers, which enable them to charge and run off the same Still upwards of Four Hundred and Eighty Times in Twenty-four Hours\*.*

**I**N our last Number we gave some account of the progress of the distillery business in Scotland; of the improvements that had been recently introduced there in the construction of the stills; and of the causes that led to these improvements.

A memorial, presented to a Committee of the House of Commons by Dr. Jeffrey, who was appointed by the Lords of the Treasury to examine the works of the distillers in Scotland, contains much curious and useful information on this subject; and, indeed, the whole of the Reports of the Committees on the Scotch Distilleries in 1798 and 1799 are extremely interesting.

The still described in our last was a great improvement; but the one we are about to describe is so powerful that hardly any evidence short of that with which the fact is supported, could make it credible. But the evidence is complete; for it is that of the distillers themselves, whose interest it evidently was to depreciate rather than over-rate the power of their stills, the duty paid on the content of the still having been from time to time increased in proportion to the acquired dexterity with which they were able to work it off.

We have already mentioned, that the first grand improvement was that of increasing the width and diminishing the depth of the still, by which a greater surface was exposed to

\* Extracted from the Reports of the Committee of the House of Commons on the Scotch Distilleries, 1798, 1799.

the action of the fire, and consequently a quicker evaporation produced. To lessen the possibility of the still running foul, and to hasten the escape and consequent condensation of the vapour, seemed to be the only points necessary to the perfecting of the process.

Dr. Jeffrey describes a still which seems well calculated to answer every end that can be desirable in such an utensil. It was constructed by Mr. Millar, a Scotch distiller of great ingenuity. Dr. Jeffrey called Mr. Millar's notice to the giving the free and most direct escape to the steam. "After mentioning to him," says Dr. Jeffrey, "that M. Beaumé had contrived a still that had many apertures in the head, and that he had found that the more of these openings he made the faster did the distillation go on, Mr. Millar set about constructing another very flat still, on the principle of giving exit to the steam at as many points in the shoulder of the still as possible. Fig. 1. Plate V. is a bird's-eye view of the apertures in the shoulder of this still before the pipes be fitted into them. Plate IV. is an outside view of the still, with its external machinery. Fig. 2. Plate V. is a perpendicular section, showing the central pipe, large below, and tapering as it rises perpendicularly upwards. The lateral pipes are oblique, truncated cones, flattened at the sides, as they ascend, to open into the central pipe. Immediately above that part of the central pipe where the lateral pipes enter, the jet and froth-breaking fly plays, while the liquor-agitating and sediment-scraping engine is worked, by machinery, below. The depth of the body is only  $2\frac{1}{2}$  inches at the centre; and, at the sides, the sole and shoulder meet at an acute angle. No sooner was this still set to work, than it was evident that the principle on which the shoulder was constructed was just; for, though the body and head held 52 or 53 gallons only, the still could work with 22 gallons of wash, if the workmen were careful; but steadily, and without foul running, for a day together, with 20 gallons; and the time between charge and charge was only three minutes at an average. I have, however, seen this still charged and discharged 21 times within the hour. In a letter, which I received a few days ago from Mr. Millar, he informs me, 'that

that he has made a new still, of the same kind, that contains only 40 gallons in the body and 3 in the head, 43 gallons in all; and that the state of working with this still is as follows:—From the commencement of the charge till the word is given to let off,  $2\frac{1}{4}$  minutes; time of discharging,  $\frac{1}{2}$  minute; making the time of charging, running, and discharging,  $2\frac{3}{4}$  minutes only, which is almost 22 times in an hour. The quantity of the charge of wash is 16 gallons, which is two-fifths of the whole content, or  $2\frac{1}{2}$  gallons more than one-third full. The charge of low wines is 24 gallons; the time of distilling from 9 to 10 minutes.' This, in so far as I know, is the fastest going still in Scotland; and, when I say Scotland, I believe I may say the world."

The following is a more particular description of the still alluded to:—

Plate IV. Fig. 4. a view of the new still, with its sediment-agitating and jet-breaking apparatus.

Fig. 1. Plate V. shoulder of the new still turned up, to show the place and size of the apertures through which the steam escapes; *a's*, the steam-escape apertures; *b's*, the plain surfaces between' the apertures.

Fig. 2. (Plate V.) a vertical section of Fig. 4. Plate IV. to show its internal apparatus; *a*, the bottom of the still joined to *b* the shoulder with folder, or riveted, or screw-nails and lute; *c*, the turned-up edge of the bottom, against which, and on a level with *a*, the brick-work of the coping of the flue rests, preventing the flame from getting up to touch *c*; *d*, the discharge-pipe. N. B. Neither the charge-pipe, nor sight or soap-hole are shown. *e, e*, the body of the still; *f*, section of the central steam-escape pipe; *g*, section of one of the lateral steam-escape pipes; *h*, outside view of another; *i, i, i*, inferior apertures of lateral steam-pipes; *k, k, k, k*, superior apertures of ditto; *l, l*, bottom-scraper or liquor-agitator, which may either be made to apply close to the bottom, or to drag chains; *m*, the upright shaft of this engine, as it is called; *n*, horizontal wheel of ditto, with its supporters; *o*, vertical wheel of ditto; *p*, its handle and shaft; *w*, support of shaft; *r*, froth and ebullition jet-breaker resting on the cross bar *s*; *t*, its upright shaft; *u*, cup-mouthed collar of ditto, filled

with wool and grease, held down by the plate and screws formerly described; *v*, general steam-escape pipe, or head.

Fig. 3. alterations proposed to be made in the form of the apertures to facilitate the escape of the steam, by taking away a great part of the shoulders on which it must otherwise impinge: *a*, the verge of the shoulder; *b*, the central aperture; *c*, the lateral apertures; *d*, the spaces between them. It is hardly necessary to add, that as the lateral apertures are very large at their base, the pipes must contract more quickly near the base than higher up.

The following description of the mode of carrying on the process of distillation at Cannon Mills, near Edinburgh, in 1798, before the improvements had been carried to their present pitch, will serve to give our readers some idea of the expertness and steady regularity of the people employed:—

In this work there are two stills generally used for distilling wash; these stills contain fifty-five or fifty-six gallons in the body, and twenty-nine in the head of each; are charged with wash up to the sight-hole, which may be within four or five gallons of the full content of the body. A very strong fire is put into the furnace below the stills; there are a quantity of iron chains affixed to a spindle, which a man, who stands on the top of the furnace, turns round, and the chains sweep round on the bottom of the inside of the still all the time that the wash is coming to boil, and when the spent wash is running off. If the wash should rise up too far in the act of boiling, and which is known by a man who keeps striking the head of the still with a stick, he gives the alarm to another man, whose sole business is to attend the furnace, and who instantly dashes a pailfull of cold water on the bottom of the still, and on the fire, which causes the wash to fall down; the fire is then stirred up to a very strong heat, and this process goes on till the steam is condensed, and the low wines run off clear. There is another man who attends at the end of the worm, where the low wines run off into a receiver, who is called the *ball-man*, and who, with an instrument, examines the low wines as they run off; and when he finds there is no more spirit remaining in them, calls out *let go*, upon which every man employed about the still is at his post. He

who

who attends the discharge cock turns it about, and the spent wash runs instantly off; which done, he gives the signal to the man on the top of the furnace, who having opened the sight-hole, turns the charging cock, and fills the still as before with fresh wash; the furnace-man dashing in coals, and the other man turning all the time the iron-work round; and the same process goes on again day and night, and the discharging the spent wash, and renewing the charge, is done in a few seconds.

The low wine still is wrought much in the same way, with this difference, that the fore-shot, as it is called, which is the first of the spirits that come off, is kept from the spirits, and returned back into the next or some succeeding operation, as are also the faints or spent low wines; the discharge of the spirits is likewise attended by a ball-man, who moves a cock placed in a receiver for receiving each separate kind, and which is done in the twinkling of an eye.

"It has been proposed," says Dr. Jeffrey, "to adapt a steam-engine to a still. There is no difficulty in effecting this: it may be said to be already accomplished, for Mr. Cartwright's steam-engine is a still and steam-engine conjoined; and it may be also observed, that a steam-engine fitted to a Scotch fast-going still would have great power; for the quantity of steam that rises from these stills in a given time is prodigious. Such an engine could grind the malt, turn the mash-stirring machine, work the pumps, &c. and it is, I think, likewise obvious, that under survey it would aid the excise in detecting frauds; for it would show when the still was at work. But however convenient and economical such a steam-engine-still might be in England, where the distiller may work when and how he pleases, it never can be profitably used in Scotland, where the distiller works against time. For, as the steam would be pent up in the still during the half of the time the beam of the engine makes a stroke, the distiller would lose that time: besides, as the heat accumulates in the wash when the steam is not allowed to escape, it is to be feared that the sediment would be frequently singed, and that of course the spirit produced would be tainted with empyreuma."

**XII.** *On the Question, whether the Sun, the Moon, and other heavenly Bodies are surrounded by Atmospheres.* By T: W. A. MURHARD\*.

**T**HIS question is of the utmost importance to the philosopher as well as the astronomer; and the more so at the present period, as the dispute between the so-called Atmospherians and Anti-atmospherians, which has been continued ever since the beginning of this century, is not yet ended. It relates in particular to the atmosphere of the moon, which was so strenuously maintained by Plutarch. But it would be as ridiculous to refer the contest to reason, as if we should endeavour to give a decisive opinion respecting a circumstance with which we are totally unacquainted. It is certain that nothing on this point can be determined *a priori*; and therefore such conclusions as are drawn from analogy must be considered as decisive. The senses must here be our guide; but it is much to be lamented, that our organs are often too weak, and our instruments too imperfect, notwithstanding the great precision to which the latter have been carried in modern times.

But we must first endeavour to establish what we mean in general by the term *atmosphere*. By atmosphere, I understand that delicate subtle body which immediately surrounds the planets, and which is mixed with those heterogeneous particles dissolved on their surfaces, or which evaporate from them. By this definition it is evident, that, according as the nature of the planet, and the particles dissolved on its surface, are different, the atmospheres must necessarily be different also; so that, by knowing the physical nature of the surface of any of the planets, we can form a conclusion respecting the nature of its atmosphere, and *vice versa*. Of this we have a sufficient number of instances in regard to the earth. Let us here only compare the pure air of the dry districts of Arabia with the air of marshy watery districts, which is continually filled with vapours, clouds, and rain, and we shall soon be convinced of the truth of this position. But

\* From *Neues Journal der Physik*, by F. A. C. Gren, Vol. III. part 4.

whether each of the planets is surrounded by such a subtle mass or not, is another question, which our experience hitherto has left in the greatest uncertainty, and respecting which we can form only probable conclusions *a priori*.

If we consider the heavenly bodies at the period of their formation, it must naturally occur, that, when created, they must have had atmospheres; for, as soon as the fixed stars began to burn, let their substance be what it might, a great many particles must have thereby been disengaged from them, and have formed a kind of atmospheres. Now, if each of these fixed stars is surrounded by a certain number of planets, its action on them must have separated from them abundance of particles, which, on account of their levity, would immediately ascend and form atmospheres around them: but as the disengaged particles could not all have the same gravity, the lighter would rise to a greater height than the heavier; and, on that account, the rarity of these atmospheres must have increased according as the distance from the planet was greater. The different aqueous, earthly, saline, sulphureous, and mineral particles form therefore in the air, belonging to each planet, what ought properly to be called its atmosphere.

That the sun has an atmosphere is admitted by all the modern astronomers. Peyroux de la Coudreniere has in particular asserted, in modern times, and his opinion has been almost universally adopted, that the sun is not a ball of fire, but that his light comes entirely from a luminous atmosphere by which he is surrounded, and which is filled with a highly inflammable vapour that forms a continual covering of fire. According to him, therefore, the sun is a prodigious burning mirror, which can effect with less waste much more than it could do were it a globe of fire. M. Schröter concludes also, from his observations, that the light of the sun arises from the luminous matter by which he is surrounded; so that hopes are entertained that, in the course of time, by making fre-

\* Heinsius, in his *Betrachtungen über den kometen von 1744*, Petersburg 1774, 4to. p. 101, makes the boundaries of each atmosphere to be in that point where the particles extricated from the planet are in equilibrium between it and the sun.

quent observations of the spots and faculæ, we shall be able to obtain a chart of the sun, as we have obtained one of the moon: for, according to this hypothesis, the spots of the sun are not clouds and thick vapours that arise from the opaque body of the solar orb. According to Peyroux de la Coudreniere, all the planets are still approaching nearer to the nature of the sun; and, in his opinion, Venus, Jupiter, and Saturn, would not exhibit such a luminous appearance were they enlightened merely by the sun. He concludes, therefore, that abundance of inflammable vapour must ascend into their atmospheres, and, by taking fire, increase their light. According to him, our earth acquires a considerable light from a like cause: and this indeed is not altogether improbable; for I myself, with a telescope of a great magnifying power, have frequently observed the heavens, by day as well as night, for this purpose alone, and have seen, in a quarter of an hour, a great many inflammations of this kind in the atmosphere. Peyroux de la Coudreniere, however, goes too far when he believes that Saturn, the remotest of the planets, seems as if inclining to remove from our system altogether; to convert himself into a sun, and to have planets revolving around him. This conceit is sufficiently refuted by the discovery of Uranus (the Georgium sidus) by Dr. Herschel.

Upon the whole, we have no certain grounds on which we can reason respecting the atmospheres of the planets. Because our earth has one, and is a planet, it does not thence follow that the rest must have atmospheres. We indeed find every where in nature the greatest diversity and variety; and if we always formed conclusions from analogy, we should fall into the greatest absurdities and errors.

M. Schröter, from the alternate obscurity and bright appearance of Jupiter, which he has observed, thinks himself authorised to conclude, that the atmosphere of Jupiter, in general, has a great similarity to ours\*. It is very remarkable, adds he, that the whitish and light zones are not always perfectly bright, but in common seem to be covered with a thin atmospheric matter, and to have sometimes a more luminous appearance than at others. It is not impro-

\* See his *Beiträge zu den astronomischen entdeckungen*, Berlin 1788. xv. bable

bable that the surface of Jupiter may reflect a very lively and white light, according to the nature of its component parts, with which we are unacquainted. The stripes observed on the surface of that planet lie in a position parallel to his equator; are subject to a great many variations; and, in general, are considered to arise from atmospheric matter liable to accidental changes. The same thing may be conjectured in regard to Saturn, on which there are stripes of the same kind, according to the late discoveries of Dr. Herschel. But in regard to the atmospheres of Mercury, Venus, Mars, and Uranus, our conclusions must be attended with still less certainty. If they have any, they must be far more subtle, and finer, than that of our earth; else these bodies would not always appear with so much brightness. The existence of an atmosphere around Mars has, indeed, been rendered highly probable by Dr. Herschel and Mr. Schröter; and the latter thinks he observed a crepusculum of  $15\frac{1}{2}$ ° in Venus, which seems to suppose that it has an atmosphere \*.

In regard to comets, I can the less venture to hazard any assertions, as some of our modern philosophers consider them to be merely nebulous bodies; I shall therefore confine what I have to say, to the moon, which still remains to be taken into consideration, and respecting the atmosphere of which there has been the most dispute. Towards the end of the sixteenth century it was strenuously maintained by Kepler. In the seventeenth the same opinion was entertained by Kircher, Scheiner, Möstlin, Fabricius, Bulliald, Hevelius, &c. In the present it has been adopted by Louville, Maraldi, Fontenelle, Bianchini, Carbone, Wolf, Bosovich, Euler, Du Scjour, Herschel, Schröter, &c. Those who opposed this opinion were, Huyghens, Cassini, Malezien, De la Hire, De l'Isle, Mylius, Tobias Mayer, Grandjean de Fouchy, &c.

Those who maintain that the moon has an atmosphere found their opinion on the following grounds:—

1. During total eclipses of the sun, a light ring has been seen around the moon parallel to her limb. This pheno-

\* See *Bodes Astronom. Jahrbuch* 1793, p. 251.

menon was observed, in particular, during those remarkable total eclipses of the sun in the years 1706 and 1715. That of the 12th of May 1706 was observed in London by Halley; in Paris, by Cassini and De la Hire; at Montpellier, by De Plantade; at Berlin, by Hofmann; at Leipsic, by Baron Von Wolf; at Dresden, by Tschirnhausen; at Nuremberg, by Wurzelbau; at Jena, by Hamberger; at Zeitz, by Teuber; and at Breslau, by P. Heinrich.

On this occasion Cassini, De la Hire, De Plantade, Wolf, Wurzelbau and Heinrich observed, during the greatest darkness, a light ring around the moon; but, on the other hand, Hofmann and Teuber perceived nothing of the kind; and those who saw the ring differ very much from each other in the accounts they have given of its magnitude and colour.

The eclipse of the sun on the 3d of May 1715 was observed at London by Halley and Louville in particular, and a ring of the same kind was observed. Rings of the like kind have been observed also at various periods.

2. Many astronomers observe, that the planets sometimes when they approach the moon's limb have a coloured appearance, change their round figure, and seem to assume that of an ellipse. It has often happened that a planet at its ingress has appeared perfectly round, and at its egression quite distorted; or, *vice versa*, distorted at its ingress, and round on its egression. The latter case I once observed myself, in regard to Venus; the former was seen, in regard to Jupiter, by M. Kastner at Leipsic. This phenomenon takes place not only with the planets but also with the fixed stars, as is proved by a multitude of instances both old and new; so that it seems to be a fact established beyond all dispute.

3. It is said to have been remarked during solar eclipses, that the limb of the sun trembles before the moon entirely touches it.

4. The diameter of the moon is said to have been observed small at the beginning and end of the darkness during eclipses, and greater at the time of the greatest darkness. On this circumstance Teuber founds his proof for the existence of a lunar atmosphere. Euler, from the diameter of the sun ap-

pearing

pearing to be magnified during the annular solar eclipse of 1748, concluded also that the moon has an atmosphere \*.

5. The moon, during serene weather, when stars of the seventh magnitude could be seen, has totally disappeared, so that she could not be discovered by the best telescopes. Several instances of this kind are related by Kepler in his *Astronomie pars optica* †, and by Copernicus in his Epitome of Astronomy ‡. The same thing was observed by Hevelius, Riccioli, &c. It is worthy of remark, that at the time when the moon disappeared to Riccioli, she disappeared suddenly also in Holland.

6. Several astronomers have found that the moon does not always appear equally bright and clear. Hevelius says, that at various times, though the weather was equally serene; though the moon had the same altitude, and was at the same distance from the earth; and though he used the same telescopes, her spots did not appear equally bright and distinct, but were more apparent at some times than at others. The same thing was observed by Erasmus Francisci, and Bulliald; and before them, by Möstlin.

7. Fiery phenomena have been seen on the moon; and from this circumstance some have concluded that she has an atmosphere. Kolben saw in 1705, not far from the line, thirty hours after new moon, the two horns of that luminary touch each other; so that she formed, as it were, a bright ring. It is related in the Breslau Collections §, that some people saw the moon, the day after she had been new, as bright as if she had been full; and Siegesbech says, in the same work ||, that in 1724, two days after new moon, he saw the same phenomenon as that observed by Kolben.

From all these circumstances it might be concluded that the moon has an atmosphere; but to these grounds, others, perhaps equally strong, might be opposed. These proofs for the other side of the question may be found in Mylius's

\* See Sur l'Atmosphère de la Lune prouvée par la dernière Eclipse annulaire du Soleil, par M. Euler, in the Mem. de l'Acad. Royale des Sciences de Berlin 1748, p. 103.

† Pages 227, 297.      ‡ Lib. V. p. 825.

§ See Breslauischen Sammlungen, XV. p. 270.      || XXVI. p. 522.

Thoughts on the Lunar Atmosphere\*, 'and T. Mayer's Proofs that the Moon has no Atmosphere†: but, without transcribing them, I shall here give a short view of them, and in the same order as I have related the grounds on which the opinion of the lunar atmosphere is founded.

In regard to the bright ring (1) which has appeared round the moon during total solar eclipses, it is evident that, even if we admit that the moon has an atmosphere, it must have been occasioned by its refraction. But experience has shown that bright rings of the like kind are produced around all opaque bodies when they are placed opposite the sun or any strong light. This was found to be the case by De la Hire, who opposed this circumstance to the opinion of Louville, who was a strenuous advocate for the lunar atmosphere. For this purpose he took an unpolished globe of stone, and, placing it between his eye and the sun, saw the interior edge of the ring, which was formed around it, broken and uneven, as Louville had seen the interior part of the ring around the moon. A like experiment was made by De l'Isle junior. He caused the rays of the sun to pass through a small hole into a darkened room; held a circular piece of lead between him and the sun; and observed, on a sheet of white paper, that the shadow of the lead was evidently surrounded by a luminous ring‡. John Cassini explained the ring seen around the moon during total eclipses of the sun from the solar atmosphere; and this was carried still farther by De Plantade. But this explanation is not necessary, as it appears that the whole phenomenon may be explained as well, if not much better, from refraction. Du Sejour, however, is of opinion, that refraction of the sun's rays at the moon's limb cannot be admitted unless we first admit a lunar atmosphere: and he shows, from Short's Observation of the Solar Eclipse in 1764, that the refraction of the sun's rays which touched the moon's limb amounted to  $4\frac{1}{2}''$ .

\* *Gedanken über die atmosphäre des mondes, Leipzig 1746, 4to.*

† *Kosmologische nachrichten und sammlungen auf das jahr, 1748. Nurn. 1750, 4to. p. 397.*

‡ See his Paper on the Atmosphere of the Moon, in the *Mémoires de l'Academie des Sciences* for 1715. *Paris 1718, p. 147.*

One of the latest instances of such a ring around the moon is that seen on the 24th of June 1778, by Don Antonio de Ulloa, between Tercera and Cape St. Vincent \*. Five or six seconds after the sun was completely covered, a very bright ring began to be seen around the moon; and this ring seemed to be in a continual and violent motion round the moon's circumference. The nearer the moon approached to the centre of the sun, it always became brighter and more luminous. Its colour was not every where the same: next to the moon's limb it was reddish; then of a pale or gold-yellow colour; and towards the exterior edge it always became whiter: but it was every where equally luminous and beautiful. All the parts of the ring seemed to be carried round the moon with the same velocity, without the order of the colours being confounded. Every thing before observed, in regard to this luminous ring, might be explained from refraction; but the circumstance, never observed on any other occasion, of its moving with a continual and uniform motion around its centre, if this was actually the case, and if it did not arise from some deception in the organs of sight, makes a new, and, according to every appearance, an almost insuperable difficulty in the explanation. It is much to be lamented that we are likely to remain in this uncertainty a considerable time; for, according to a calculation of M. Du Vauzel †, a total eclipse of the sun, visible at Paris, will not take place for 120 years, and none can occur visible in any part of Europe till the year 1816 ‡. From the above observation Don Antonio de Ulloa does not hesitate to conclude that the moon has an atmosphere.

I shall now proceed to the second point, adduced as a proof

\* See his *Observation de l'Eclipse du Soleil totale du 24 Juin 1778*, in *Rozier's Journal de Physique*, Vol. XXV. part 1. April 1780, p. 319; also *Mémoires de l'Acad. Réunie des Sciences à Paris 1778*, Paris 1781, p. 64; and Don Antonio de Ulloa's Observations on the total Eclipse of the Sun on the 24th of June 1775, in the Swedish Transactions, Vol. XL. Leipzig 1783, p. 225.

† Vol. V. Des Mémoires présentés.

‡ See Peter Wargentin's Paper on the luminous Ring with which the Moon seems to be surrounded when she entirely covers the Sun, in the Swedish Transactions for 1778, Vol. XL. p. 251.

of the moon having an atmosphere. Some suspicion is excited in regard to the accuracy of this observation, because many astronomers, during the same celestial occurrences at other times, have never observed the smallest change of figure in the stars either during their ingress or egress. De la Hire\*, however, observed, during an occultation of Jupiter by the moon, that when Jupiter was at the distance of 12' from the moon, he showed the same lively colours as when he approached nearer. But, to make these colours appear, it was necessary that Jupiter should be at the edge of the aperture of the telescope; for when he was in the middle of it none were seen. From this circumstance he naturally concludes, that the colours did not proceed from the moon, but from the glasses of the telescope, which, as they are convex, form at their edges a sort of circular prism. Venus, which appeared soon after, exhibited the same colours as Jupiter. T. Mayer, therefore, gives this excellent rule: Make the experiment without prejudice, and take care to use the telescope with the necessary precaution: it will then, perhaps, be found, that the planets and fixed stars approach the moon at all times in their proper form. De l'Isle ascribed this phenomenon to the inflexion of the rays alone †.

We now come to the third argument adduced in favour of the lunar atmosphere, or the tremulous motion of the sun's limb before he touches the moon during a solar eclipse. This undoubtedly arises from our atmosphere alone; and we have so many instances of such quivering on other occasions, that I do not think it necessary to say any thing farther respecting it. This is certainly one of the weakest proofs advanced in favour of a lunar atmosphere.

In regard to the fourth proof, that the diameter of the moon at the commencement and end of eclipses has been observed to be smaller, and at the time of the greatest darkness to be greater, it appears to be almost void of foundation; and indeed we have more instances of such a phenomenon not being seen, than of its being observed. During the total

\* Mémoires de l'Acad. de Paris 1715, p. 148.

† Mem. pour servir à l'Histoire et au Progrès de l'Astronomie. Paris 1738, p. 249.

solar eclipse of 1669, nothing of the kind was discovered; and this was the case in regard to that of 1706, which Hofmann observed at Berlin. Tobias Mayer, also, during the great total eclipse of the sun in 1748, though he made his observation with the utmost attention, could perceive no such thing.

I must now say a few words respecting the fifth and sixth proofs. The cause of both these phenomena lies, no doubt, in our atmosphere, and not in that of the moon; for the phenomena have been seen in one place and not in another.

These are the grounds on which the existence of the lunar atmosphere may be contested: but it appears to me, that we should decide too rashly were we to deny altogether that the moon has an atmosphere; for we may still admit one, though it may be of such a nature as to elude our senses. There are many things in nature which our imperfect organs of sense are incapable of perceiving; but it would be ridiculous on that account to deny their existence. I need only request the reader to recollect the phenomena of general gravity or attraction, magnetism, &c. This much, at any rate, is certain, that if the moon has an atmosphere, it must be of a nature totally different from that of our earth. This will appear the more evident, if we consider that, according to all the observations hitherto made, the moon does not abound with such seas and rivers as our earth. M. Schröter conjectures, that as the moon, in regard to the sun, turns round her axis only once in 29 days 12 hours, this monthly change of day and night may probably have a considerable influence on the lunar atmosphere, and supply the place of our seasons. Of this he is the more convinced by the monthly change in the colour and spots of the moon which he has remarked. The atmosphere of the moon must be different from that of the earth, not only in regard to its brightness and transparency, but also in regard to its power of weakening and breaking the rays of light. But on this subject nothing decisive can be obtained from all the observations hitherto made \*.

\* See Schröter's Observations on the Atmosphere of the Moon in the *Götting. gel. Anzeig.* 1792, No. 86.

We are equally ignorant in regard to the solar atmosphere; which is said to give rise to the so called zodiacal light. In that case, however, it must not be of a globular form, like our atmosphere, but extend round the sun's body like a kind of zone. From this solar atmosphere M. Mairan \* deduces the northern lights; but this opinion has been, in some measure, refuted by d'Alembert †.

The result of what has been here said, is, that respecting the atmospheres of the celestial bodies we know very little; and as the observations on this subject require to be made with the utmost accuracy and attention, it will be a long time before our knowledge on this head can be much enlarged. It is to be hoped, however, that those who possess acuteness of sight, and good instruments, will endeavour to determine this point, for which no person seems fitter than Dr. Herschel.

*XIII. On the Advantages which result from substituting Oak Bark for Gall Nuts in dyeing Black, especially in dyeing Hats.*

**D**IMO STEPHANOPOLI, a Corsican, and a surgeon in the French army so far back as the year 1782, proposed oak bark as a substitute for galls; and the examination of his process was referred by the Government first to Macquer, who gave a favourable report of the result, and afterwards to Berthollet, who was of a different opinion. Several other means for determining the advantages or disadvantages likely to result from a general adoption of the process were had recourse to. Lately it was revived by the Lyceum of the Arts, from whose report we extract the following account:—

“ Experiments were made, by order of the College of Pharmacy, at the manufactory of Beaujolin and Morel. Two boilers, of about two hundred and twenty hats each, were made ready, one for the gall nuts and the other for the

\* See his *Traité Physique et Historique de l'Aurore Boreale*, second édit. Paris 1754, 4<sup>to</sup>.

† See his *Opuscules Mathématiques*, Vol. VI. p. 334.

bark. Twelve hats in each were marked : they were of the same stuff and the same size, had been prepared with all the precautions which each of the two methods required, and the whole process was carefully observed by a commissioneer who attended for the purpose. After all these hats had been properly dried, cleaned, and brushed, they were placed indiscriminately on a table. Several of the most expert dyers of Paris were invited to select, from the twenty-four hats, the twelve which should appear to them to be the best dyed. These dyers arrived separately at two different times, so that there were two selections ; and in both cases, one hat excepted, these dyers pointed out as the best dyed those hats which had been treated with oak bark. Was any thing more necessary to determine which method deserved the preference ? The fate of this new process however, which to success in the operation of dyeing, unites economy, and the advantage of freeing us from paying tribute to a foreign nation, has remained in a state of uncertainty.

" One of the strongest objections which has been made to dyeing black with oak bark, is the considerable difference between the quantities of the precipitates ; and we must say, for the information of those unacquainted with the subject, that the black matter of the dye, of which we here speak, results from the combination of an acid, called the gallic, with iron ; and in the operation we are describing, the quantity of this acid is generally determined by knowing how many parts of iron (furnished by sulphat of iron, commonly called *green copperas*,) have gone into a known quantity of the precipitate : the remaining parts which are necessary to make up the known quantity are counted as gallic acid.

" If the decoction of a given quantity of gall nuts be poured on a solution of the sulphat of iron, you obtain a black precipitate ; and if the same operation be performed with a decoction of oak bark, and in the same quantities, you will have also a black precipitate, with this difference, that the gall nuts will have produced eight or ten times as much as the oak bark : but this abundance in the gall nuts is only apparent, and is owing to a sort of feculent matter, or gum, which adheres to the acid and is carried down with the pre-

cipitate, where it cannot but diminish the intensity of the black. In a word, to be convinced of these truths, it will be sufficient to give a comparative view of the two processes, and of their results. We shall suppose, therefore, a kettle for twenty-five dozen of hats, as is the case in several manufactories. That quantity will require twenty-five pounds of gall nuts and the like quantity of sulphat of iron, about 150 or 200 pounds of logwood, and twelve pounds of acetat of copper (verdegris), and from 100 to 125 pails of water. The gall nuts and logwood must be boiled for about six or eight hours, which will reduce the decoction to about a third. The fire is then diminished, to throw in, portion by portion, the sulphat of iron and the verdegris. In this manner the bath is prepared, and you plunge into it the felt or hats, which are to be drawn out and again immersed different times, as experience has shown that atmospheric air contributes a great deal towards the efficacy of the operation of the dye. There is some difference in the method of manipulation; but this depends on the practices followed in different manufactories: in regard to the doses, they are nearly every where the same.

" The method of Dimo Stephanopoli consists merely in substituting oak bark in the stead of gall nuts in the proportion of a half, that is to say, twelve pounds and a half instead of twenty-five. It requires no other preparation before it is employed than to be cut, or coarsely broke.

" This bark furnishes a dye much fuller, as well as more beautiful and more durable; and the operation becomes much easier, for it is not subject to what is called burning. It is free from an immense quantity of sediment, which is found in the bath when gall nuts are employed, and which communicates a dust that can be removed only by a rod or brush, which, however, requires tedious and troublesome labour.

" By forming an estimate at the usual prices, in the operation above mentioned, the gall nuts employed cost 75 francs, and the oak bark 14 sous \*. Janin, in the street Avoie, proprietor of one of the largest hat manufactories at Paris, and

\* One hundredth of the price of the galls.

who

who dyes twenty-five dozen of hats at a time, has employed for ten years, with constant success, the process of Stephanopoli. He assures us, that from his own experience oak bark deserves in every respect to be preferred to gall nuts.

Morel, hatter, near the gate of St. Martin, one of those who first employed the process of Stephanopoli, has never discontinued it. Huaut, in the street des Menestriers, had formed an establishment for dyeing hats, but for want of proper encouragement he was on the point of abandoning his enterprise. Morel, however, advised him to pay a visit to Stephanopoli, from whom he obtained the process; and since that time he has succeeded. He declares that he is under the greatest obligations to Morel, and the author of this new method. He regularly heats a kettle of 300 hats every twenty-four hours. Both Janin and Morel have for several years past received many letters from their customers respecting the beauty and durability of the dye of their hats, and, according to their declaration, only since they employed oak bark.

" It results from what has been said, that oak bark is preferable, in every respect, to gall nuts: that, being a production of our own soil, it will free us from paying tribute to foreigners; and that a scarcity of gall nuts, or accidents which may happen to prevent a supply of that article, can no longer hurt the manufacture of hats in France, which is of so much importance, and that of wool dyed black, &c.

" We have not entered into all the details which this subject would admit; it is susceptible of great extension, and, in many respects, may be considered as new. It cannot be doubted that the operation called *galling* might be performed with oak bark, and it is to be regretted that the researches of Lapalle, Member of the Constituent Assembly, on this object were not published.

" The use of oak bark was already known in some branches of dyeing, and this use of it had been mentioned by several authors. To conclude: We are certain that, in the dispute respecting oak bark and gall nuts, the views of each party were equally pure; but experience alone was able to remove every difficulty, and the Assembly must have seen that there

remains no longer any doubt respecting the importance of the service rendered by Stephanopoli. His method will be introduced and extended in our manufactories, to the advantage of several branches of industry and of the general interest."

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#### XIV. *Some Account of the late PETER CHARLES LE MONNIER.*

PETER CHARLES LE MONNIER, the oldest astronomer in Europe at the time of his death, which happened on the 2d of April 1799, at Lizieux in Normandy, was born at Paris on the 20th of November 1715. At a very early period of life he applied to the study of astronomy, and made his first observation of the opposition of Saturn on the 23d of September 1731, when he was only sixteen. At the age of twenty he was chosen a member of the Academy of Sciences at Paris. In 1735 he was sent to Lapland, along with Maupertuis, to measure a degree of the earth: In 1748 he accompanied Lord Macclesfield to Scotland to observe the annular eclipse of the sun, which could be seen with most advantage in that country; and he was the first astronomer who had the pleasure of measuring the diameter of the moon on the sun's disk.

Louis XV. who was fond of and patronised astronomy, showed a great esteem for Le Monnier. When his Majesty wished to observe any of the celestial phenomena, he always attended him; and it appears, by the memoirs of the Academy of Sciences at Paris, that the King observed in this manner, at his country palace of St. Hubert, both the transits of Venus over the sun's disk in the years 1761 and 1769. It is worthy of notice, and deserves to be here recorded, how much his Majesty seemed to be interested in the success of these observations, and how careful he was not to interrupt the astronomers during the course of their operations. Le Monnier, in his paper on this subject in the Memoirs of the Academy, says —“ His Majesty perceiving that we considered the last contact to be of the utmost importance, we were at that moment surrounded by the most profound silence.”

silence." During the transit of Venus in 1769, his Majesty allowed that able naval officer the Marquis de Chabert, who had just returned from a scientific voyage to the Levant, to have a share in the observations made on that occasion.

In the year 1750 Le Monnier was requested by the King to draw a meridian line at the palace of Belle-vue, where he often made observations; and his Majesty for this service gave Le Monnier a present of 15,000 livres (about 600*l.* sterling). In 1742 his Majesty gave him a house in *Rue de la Paſte* at Paris, where he resided and made observations till the period of the Revolution. In 1751 the King presented him with a block of marble eight feet in height, six in breadth, and fifteen inches in thickness, in order that he might affix to it his five feet mural quadrant. This large mass of marble, with all the instruments attached to it, moves on a large brass globe, by which the quadrant can be turned from south to north, and by which the great eight feet mural quadrant, which is fastened in an immovable position to a wall fronting the south, can be adjusted.

With these quadrants Le Monnier, for the space of forty years, observed the moon, with unwearyed attention, at all hours of the night. No person but a diligent astronomer can know to what inconveniences one is exposed in making an uninterrupted series of observations of the moon. As the moon, during one revolution, may pass the meridian at every hour of the day and the night, which is the moment for observation, the astronomer who pursues these observations must be prepared at all hours of the day and night, and sacrifice sleep and every other enjoyment.

Le Monnier was Lalande's astronomical preceptor; and the scholar has, indeed, shown himself worthy of the master. The discerning mind of Le Monnier could readily foresee in young Lalande, then only sixteen, what the course of a little time afterwards confirmed. In the twentieth year of his age Lalande, on the recommendation of his preceptor, was elected a Member of the Royal Academy of Sciences; and in 1752, on a proposal made by him, he was sent to Berlin along with La Caille, who afterwards undertook a voyage to the Cape of Good Hope to make corresponding observations, in order

to determine the parallax of the moon, which never had been accurately ascertained. On this occasion Le Monnier lent to his pupil his five feet mural quadrant. His zeal for the promotion of astronomy was boundless; and therefore Lalande says, in his *Notice des Travaux du C. Le Monnier*, “I myself am the principal result of his zeal for astronomy.”

Le Monnier was naturally of a very irritable disposition, and, though warm in his friendship, was easily offended: in that case his hatred was irreconcileable. Lalande, as he says himself, had the misfortune to incur the displeasure of his preceptor, for whom he entertained the utmost affection, and whose good graces he was never able to recover. But Lalande never ceased to show his esteem and gratitude for him till the latest day of his life. “I never ceased to declare,” says Lalande, “as Diogenes did to his master Antisthenes, You will never find a baton sufficiently heavy to drive me away from you.” In the year 1797 Lalande wrote an eulogy on Le Monnier for the *Connoissance des Temps, année 9*, which displayed the utmost respect and esteem of the pupil towards his preceptor; but Le Monnier would never read it\*.

Hennert, that celebrated geometrician and professor of mathematics at Utrecht, may also be considered as a scholar of Le Monnier, as appears by the following extract from one of his letters, dated May 26, 1797:—“Le Monnier is an acute and philosophic astronomer. I learned a great deal from him while I resided at Paris, though I lodged at the house of the late De l’Isle, where I often observed with Messier. Le Monnier was a great friend of D’Alembert, and consequently an opponent of Lalande.”

Le Monnier left behind him a great many valuable manuscripts and a multitude of excellent observations, which he was very fond of keeping to himself, and which, in the latter period of his life, he never made known. Besides others, he had a series of important observations of the moon, and a great many observations of stars, made for a catalogue, which

\* It may not be improper here to remark, that Lalande had a great friendship and respect for that eminent astronomer La Caille, whom Le Monnier mortally hated. Le Monnier and D’Alembert were also great friends, but Lalande had no kind of intimacy with the latter.

he announced so early as the year 1741, and among which there were two of the new planet Uranus. The more he was entreated to communicate them to the public, the more obstinate he became in withholding them; and he even sometimes threatened to destroy them. When the Revolution broke out, Lalande, who was exceedingly anxious for the preservation of these papers, made an attempt to get them into his possession; but his exertions were fruitless. He could only learn, that Le Monnier had concealed them under the roof of his house. When Le Monnier was attacked by the first fit of the apoplexy on the 10th of November, Lalande was therefore afraid that, as no one but himself knew where these papers were hid, the old man, through mental debility, might forget where he had placed them. Le Monnier left three daughters, all married; the second of whom was married to the celebrated mathematician La Grange on the 31st of May 1792.

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## INTELLIGENCE,

AND

## MISCELLANEOUS ARTICLES.

ROYAL SOCIETY OF LONDON.

**T**HE reading of Dr. Hulm's interesting paper on the spontaneous emission of light by various bodies, was concluded at the meeting of the 27th of February.

An ingenious paper on refraction, by Dr. Woolaston, was read on the 27th of February and 6th of March.

At the latter and the subsequent meeting on the 13th, a paper, by Mr. Henry, of Manchester, on attempts to decompose the muriatic acid, was read. The experiment was made by means of the electric spark on the acid in its gaseous form, but without success. Mr. Henry is of opinion, that the result looked for will never be obtained by means of single elective attraction; and that, if ever a knowledge of the

the base of this acid be got at, it must be by means of the most complicated affinities.

A paper, by Mr. Howard, on his newly discovered fulminating oxyd of mercury, of the powerful effects of which we have already taken some notice, was read on the 13th and 20th. The process for preparing it we cannot yet fully describe, but it consists in digesting nitrat of mercury in alkohol. A precipitate is thrown down, which, on being carefully washed, to free it from the nitrous acid, possesses the fulminating property formerly noticed. Experiments with this substance should be carefully conducted, and in very small quantities, to prevent accidents.

#### FRENCH NATIONAL INSTITUTE.

In the public sitting of the 15th Nivose, year 8, January 5, the following account of the labours of the Physical and Mathematical Class during the preceding three months was read by C. Cuvier.

C. Guyton has presented a table of the direct combinations of forty-two chemical elements; that is to say, of substances which the chemists have never been able to decompose, and which they must consider as simple till proofs of the contrary are obtained. These forty-two substances, combined only two by two, give 861 different combinations, with the half of which we are not yet acquainted. Combining them three by three, and four by four, paying attention to the proportions of the constituent parts of each combination, the number of the latter increases in such a manner as to excite astonishment. One might be inclined to consider our ignorance respecting the greater part of these combinations as a proof of the imperfection of science; but so far is this from being the case, that it is by the immense progress science has lately made that we are enabled to know that these combinations are possible.

Among the substances with which modern chemistry has been lately enriched are in particular some semi-metals, one of which, by its discoverer, Professor Klaproth of Berlin, has been called Uranite, from the planet Uranus of Herschel, as the common metals received from the alchemists the

names

names of the seven old planets. C. Champeaux, *ingénieur des mines*, is the first who discovered Uranite in France. The details of this discovery have been communicated to us by C. Lelievre.

Chemists have given the name of affinity to that power by which different substances tend to unite with each other, and which properly forms the object of all their researches; for chemistry will never be complete until we obtain a table of the degrees of affinity of each substance for all the rest under given circumstances. What renders it difficult to form such a table is, that these affinities do not preserve the same order in all circumstances. It has been long known, for example, that this order varies according to the degrees of heat; but several other causes, to which chemists have not hitherto paid sufficient attention, concur also to render it uncertain. C. Berthollet has been employed on this part of chemistry, and has presented on that subject a work of great labour, a portion of which he communicated to the Institute of Egypt, and which proves, that in going to search for new facts in a distant country, he has been the occasion of making new progress in the theory which ought to unite them.

Among the causes which change the order of affinities is, the respective quantities of each of the substances brought into contact. One substance, which would exercise no action if it entered the mixture in a quantity equal to the others, exercises a very perceptible action when its quantity is considerably augmented: it seems, then, that the different parts of each substance unite their efforts to overcome the resistance opposed to them.

Another of these causes is, the greater or less cohesion of one of the substances or mixtures. It augments the resistance to the change which the affinities ought to produce.

A third cause is elasticity, which lessens the tendency to combination. Thus any substance, oxygen for example, acts with a far greater force when concentrated in a liquid combination than when it is under the elastic form. The action of heat seems to enter into this third cause. It may be possible that it does not alter the affinity of the different substances but by producing changes in their respective elastici-

cities: if two or more substances, then, which enter into any mixture, are of such a nature as to produce an elastic, concrete, or even insoluble compound, we must no longer calculate their effect in the definitive result according to the absolute affinity belonging to each, but must deduct what this concrete or elastic state takes from the affinity. It may readily be perceived what light the application of these principles, which have never been before considered in their general extent, must throw upon all the phenomena of chemistry.

C. Berthollet, by means of these principles, has been able to bring under the common laws of chemistry a multitude of facts which seemed insulated, or even contrary to these laws. Hitherto, for example, the affinities of the greater part of these compound bodies were considered independently of those of their compounds, because the circumstances above mentioned were not taken into account. C. Berthollet clearly shows that in many cases they depend on each other; and how, from so small a number of elementary substances, when chemically considered, so many compounds, and effects so various as those exhibited by Nature, can be produced.

Besides the table before mentioned, C. Guyton has presented to us four others, destined, like the first, for the instruction of the pupils in the Polytechnic School. One of them contains a methodical distribution of minerals into orders, classes, genera, and species. Another gives a complete system of the external character of minerals according to the principles of Verner, with additions. The object of the third and fourth is, to facilitate to beginners Haüy's theory of the structure of crystals, by presenting in a series the first molecule of a crystal, its nucleus, and the different modifications produced by the laws of decrement, and by giving, according to the graphic method, a key to the formulæ which represent these modifications, and the solids resulting from them, without losing sight of the nucleus.

Some of the naturalists of the Class have employed themselves, during the last quarter, on the remains of organised bodies discovered in places where living animals analogous to them do not at present exist.

C. Villars,

C. Villars, associate, has announced to us that he found fossil wood in the turf on one of the highest mountains of the Alps, near a glacier, and at the height of more than 2280 feet above the nearest forests now in existence. This fossil wood consists of trunks of larch, birch, and mountain-ash, with their roots in perfect preservation. Their situation gives C. Villars reason to believe that they grew on the same spots where they are buried. But how has the cold become so violent that the same trees can no longer live at such a great altitude? C. Villars assigns the cause to the sinking down of the summits of these mountains; their wasting in consequence of being washed away by the rains; and the imprudent destruction of wood by the hand of man.

A fact no less curious has been communicated to us by Poiret. He has found fresh-water shells in strata of turf, and covered by other strata of the same turf containing marine shells. The soil which presented these objects must then have been first watered by rivers, and afterwards inundated by the sea, though at present it is found in the middle of the Continent.

C. Beavois, associate, has brought us, from North America, proofs of changes no less astonishing in the state of the earth. The remains of enormous quadrupeds, absolutely unknown at present, have been found there at various periods; but C. Beavois has shown us bones different from any hitherto dug up. Each day, and every climate, furnishes proofs of the revolutions which our globe has experienced, and which are imprinted on its surface and in its bowels in indelible characters.

In Botany, the Class has received from C. Broussonet valuable observations on such plants in Morocco and the Canary isles as are either useful or new. In these islands the inhabitants cultivate the *mesembryanthemum crystallinum*, from which they extract soda, and which by combustion gives a third of its weight. C. Broussonet is of opinion, that this plant might be cultivated in the department of Var, between Montpellier and the sea.

C. Tessier has communicated observations on a disease in

millet, which he calls *charring* (the smut). It is propagated by communication, and may diminish the crop one-half.

C. Desfontaines presented the second and last volume of his Flora of Mount Atlas. This work, which, on account of the correctness of the descriptions and the beauty of the plates, may be ranked with any thing of the kind ever yet published, is a striking proof of the zeal of its author, who collected the materials in the deserts of Africa, where he was every moment exposed to new dangers.

C. Ventenat has communicated a very extensive work on the lime-tree. He has described seven species unknown to Linnaeus, several of which might be naturalised in our gardens; and particularly one, which, no doubt, would be preferred to the common lime on account of its leaves, which being thicker, resist better the heat of summer; and of its flowers, which are sweeter and last much longer.

Our anatomists have been employed chiefly in unfolding the organisation of two animals of the simplest kind and the most distant from man. One of them, named the *medusa*, is found in the waters of the sea, where it is nourished not by one mouth, as all the other known animals, but by a multitude of small tubes, which may be compared to roots. Its stomach supplies the place of a heart, and conveys the nutritive juice, through ramified vessels, to every part of the body.

The second, to which C. Huzzard has called the attention of the Clas, is found in the interior part of the brain of sheep, and never any where else, though it is difficult to conceive why this should invariably be the case. This animal occasions a mortal malady, the symptoms of which are, that the sheep affected jump and run round with a sort of convulsive movement. The body of this animal forms a vesicle filled with water: on one body there are several heads, and each head has a mouth. A special commission has been appointed to endeavour to find out the best means for destroying this singular insect.

C. Chaptal has made known to us a new method for bleaching cotton,

C. Loisel,

C. Loisel, associate, has published a complete treatise on all the processes in regard to the art of glass-making.

C. Sabbatier has shown, that it is often possible to save those who have the upper part of the arm shattered, or the head and neck of the humerus attacked with caries or exostosis, from the cruel and dangerous operation of amputating that limb at the joint, that is to say, at the place where it is joined to the shoulder, merely by extirpating the upper part of the bone. Several persons treated according to this method have experienced no sensible decrease in their strength or the mobility of the arm.

#### GASEOUS OXYD OF AZOT.

We have already had occasion to mention the result of some experiments made at the Medical Pneumatic Institution, Bristol, with this new gas, and the hopes these afforded that it would prove a powerful remedy for various diseases. The following extract of a letter, with which we have been favoured from Dr. Beddoes, gives some farther information on this subject, that cannot fail to prove interesting to our philosophical readers:—

“ SIR,

“ I am sure it will give you pleasure to hear that the *gas* which you noticed in your Magazine has fully maintained its character. The inference I could not fail to draw from the first effects, with regard to its power in curing palsy, has turned out just. You will undoubtedly believe that I do not mean to affirm that it will prove an infallible remedy in paralytic complaints; but in the most inveterate cases of hemiplegia, originating in apoplectic seizures and confirmed by repeated strokes, it has restored feeling and the power of voluntary motion to the affected side; and I am persuaded it will continue to do as much in a large proportion of instances. The full details will be given in a work by Mr. Davy and myself, now in the press. No untoward accident has occurred in the many hundred trials lately made with the *gas*: but a few hysterical females having cautiously respired it, there has been reason to think that a larger dose would have given rise to fits, as stated in my *Notice*.”

We

We may take the present opportunity to mention, that we understand Dr. Beddoes means soon to give *Lectures on the Laws of Animal Nature, and on the Means of preserving the System from Injury upon the most important Occasions of common Life.*

"A popular exposition of the principles of the animal economy, with their application to the purposes of individual and domestic welfare, upon a plan widely different from that of any existing publication, has long been seen necessary by many people..

"Heretofore an acquaintance with the causes of his personal condition has seldom been numbered among the *ac-complishments* of the scholar, or the *qualifications* with which the man of business is fitted out for success in the world: yet it will be confessed, that neither success in business, nor proficiency in the sciences accounted *liberal*, are separately sufficient for rendering the condition of human life desirable; and, in fact, to endeavour, by any combination of these materials, to construct a system of personal happiness, is to project an edifice which shall stand secure without a foundation. Of a truth, so long and so generally neglected, a portion of the public, it is believed, begins to feel that degree of conviction which operates upon conduct.. In this belief, the present opportunity of instruction is offered to those who may be desirous of it.

"Numbers fall victims to their own impatience under illness, or to the wavering conduct of their friends. Frequently on the onset of dangerous diseases, people, by suffering themselves to be amused by trifling domestic expedients, lose an opportunity which no medical skill can ever retrieve. Upon these evils the prevalence of jester ideas would act as a check. Nor is it paradoxical to suppose that the mortality among infants would be smaller, and debility of constitution at all periods of life more rare, if parents (however instructed in other things) were not in common nearly upon a level with nurses in that which it so much imports them to possess—an acquaintance with the powers that operate to the injury or advantage, the destruction or preservation, of the objects of their affection."

The Lectures are to be calculated for both sexes and different ages; and that there may be little chance of exclusion by reason of narrow circumstances, the subscription is fixed at One Guinea; but, unless fifty persons shall have entered their names by the 31st of March, the Lectures will not go on, as, without a tolerably numerous audience, Dr. Beddoes thinks he could bestow his time in a manner more advantageous to the public.

We sincerely hope nothing will prevent this useful design from being carried into effect.

#### COW POCK.

*Extract of a Letter from Dr. De Carro of Vienna, to Dr. Pearson.*

" DEAR SIR,

" Two Hanoverian gentlemen, Dr. Ballhorn and Mr. Stromeyer, who, as you know, are making experiments with cow-pock, and with whom I correspond, informed me that this disease is very well known in Holstein, and that a certain Dr. Nessen, of Siegeberg, has collected many facts which prove its anti-variolous property. Being myself lately in company with several English gentlemen, who were putting to me many questions on the subject of cow-pock, an American gentleman, Mr. Murray, of Philadelphia, told me that his servant, a German, had lived three years in the Duchy of Holstein, and that he thought he recollects that he had mentioned to him some facts which coincided much with what I was telling them about the cow-pock. This gave me the curiosity of speaking to that servant, who, he told me, was very intelligent, and had shown often a spirit of observation. Here is the summary of his answer:—That during a stay of three years in Holstein, in the environs of Kiel, he had very often heard of a disease of cows called *Die Finnen*, (*finne* means, in general, a pimple, *un bouton*; *finnig*, pimpled, *boutonné*,) and that he had had frequent occasion of seeing cows affected with that disease: that its property of preserving against the small-pox is well known by the farmers and physicians of the country: that, in the town of Kiel, the inoculation with the *finnen* is sometimes practised upon children

dren in the idea of preserving their beauty: that the country-people do not like this inoculation, because they pretend that it leaves behind it several other disorders: that, waiting at table, he had very often heard gentlemen, and among others a Dr. Ackermann, speak of its anti-variolous power: that in great farms men do not milk cows, but that in the smaller ones that happens very often: that a disease of horses called *mauke* (true German name for *grease*) is known by all those who take care of them: that old horses particularly, attacked with the *mauke*, are always put in cows' stables, and there are attended by women: that it is particularly in harvest that men in small farms milk cows: that he never heard of any relation existing between the *finnen* and the *mauke*. He describes that disease of cows like a pimple between flesh and skin (that is his expression); and says, that when a cow is affected with it, she loses her milk and becomes very lean: that farmers kill the sick ones to prevent the contagion: that they sometimes salt those cows, and give them in winter to eat to their servants, who dislike the flesh so much that they look upon this treatment as a mark of avariciousness: and that the pustule produced by inoculation is about the size of a pea, and is never attended with any other eruption."

#### HEAT AND LIGHT.

Dr. Herschel, whose discoveries have already tended so much to the increase of science, has, we understand, made a discovery within these few days past that bids fair to place his name higher than all the researches he has yet made—he has found out a method of separating the rays of heat from the rays of light.

#### ECONOMY IN COOKING.

Into a digester used by the Soup Committee of Manchester was lately put a large bone of beef, from which all the meat was carefully cut and scraped away, and which weighed when put therein  $25\frac{1}{2}$  ounces, and when taken out again only 10; so that there was gained of good and wholesome food  $15\frac{1}{2}$  ounces, or full three parts in five of what is usually lost in the economy of it.

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THE

# PHILOSOPHICAL MAGAZINE.

APRIL 1800.

I. *Description of the Island of Borneo, with some Account of the Manners and Customs of its Inhabitants.* By Mr. VON WURMB\*.

THE Portuguese, Dutch, and English, ever since the sixteenth century, have in turns endeavoured to establish themselves in this island, which is one of the largest in the Indian ocean; but the Dutch alone, by being so fortunate as to have a preponderance in India, were able to accomplish their object. On account of the gold and diamonds found here, as well as of the pepper, of which the Dutch East India company export annually 600,000 pounds, this island is of considerable importance to their trade.

It is reported that, when the Portuguese wished to form a settlement here in the year 1526, they presented to the sultan of Landac and Succatana some beautiful pieces of tapestry on which figures of various kinds were represented; but that the sultan, who took these figures to be animated or magic figures, and apprehended that they might unexpectedly rush from the tapestry and strangle him, rejected the present, and expelled the Portuguese, with their presents, from the country. The English were not much more fortunate, having quitted Borneo entirely ever since the year 1706. In 1766

\* From *Merkwürdigkeiten aus Ostindien*, published by the author's brother.

they made an attempt to form a settlement in the island of Balambangan, at the northern extremity of Borneo, which was given up to them by the king of Solon. They had in it a few Europeans for the sake of trade, and a garrison of three hundred soldiers, Europeans and blacks. Their view was to establish here a factory, where they might exchange the productions of Europe and Hindostan for those brought hither from China and the Indian islands; but in the year 1772, after a part of their troops had been swept off by contagious diseases, the fort they had constructed, being badly fortified, was suddenly attacked, and the whole establishment destroyed. The English are still ignorant who were the authors of this violence; and they do not know whether they ought to ascribe it to the Dutch, jealous of their trade in that neighbourhood, or to the Spaniards, afraid of their possessions in the Philippines.

Various accounts of Borneo may be found in the works of different authors; such as Valentyn's General Description of India, Salmon's Present State of all Nations, the General History of Voyages by Prevost, and the paltry compilation of the abbé de la Porte. But as this large island is as yet little known even in India, and as no European has been able to penetrate to the interior part of it, all these descriptions are erroneous and imperfect. That I may therefore give the public the latest and most authentic information respecting this island, I shall confine myself chiefly to the account of it published in the Transactions of the Society for promoting the Sciences at Batavia, in the island of Java. The island of Borneo extends from the fourth degree of southern latitude to the eighth of northern, and from the hundred and fiftieth to the hundred and fifty-eighth of longitude. It is about 780 miles in length and 720 in breadth. Its climate is almost the same as that of Java; but Borneo is less mountainous, and the land, for twelve or fifteen miles, and sometimes more, from the coast, is almost every where marshy. The remaining part of the island is sufficiently fertile, and would be productive were not the natives too indolent to cultivate the soil, and fonder of searching for gold and diamonds, which they barter with the Javanese

vaneſe for various necessities of life. The middle of the island is occupied by an extensive ridge of mountains called the Crystal Mountains, because a great quantity of crystal is found in them. At the bottom of these mountains is a large inland lake, which gives rise to all the rivers that tra-verse the whole island.

The real natives of this island are the Biadjoos or Dajak-keſe, who live in the interior parts of the country. The sea-coast is inhabited by a mixture of Malays, Javanese, and Ma-cassars. It is only of the countries situated on the coast that we have any certain accounts, for the interior parts of the island are as yet very little known.

The greatest kingdom in the island, and the most important on account of its connection with the Dutch East India company, is that of Banjermassing on the southern side. The great river Pontiana, which is navigable for ships that draw from twelve to thirteen feet of water, is exceedingly convenient for trade. The sultan Sufuhunan Natahalam, since the year 1771, has transferred his residence from Cagu-Tangie to Martapura, where he caused a large city to be built, and a canal to be dug which passes through the middle of it; at the same time the name Martapura was changed into Bumie-Kintjana. The reader may from this readily conceive that the power of this sultan is not inconsiderable. The inhabitants of the city, as well as those who reside in places at a distance from the coast, are mahometans, mixed with a great many Biadjoos or Dajakkeſe, who are pagans. These Biadjoos, who inhabit a great many villages, the number of which is said to amount to 784, are ſubje&t to various petty princes, who acknowledge the sultan as their superior. Of these Biadjoos, who are the original natives of the island, I shall speak hereafter.

The factory of the Dutch East India company is situated at the end of the village of Tatas, or Banjermassing. It con-fists of an octagonal fort surrounded by palisades, which on the east side next the river is furnished with three, and on the west, or land side, with two bastions. The produc&tions of the country ſought for as articles of commerce, are pepper, gold, (moſtly gold-duſt, not very abu&ndant in metal,) dia-

monds, canes, birds-nests, wax, pedra del porco, dragons-blood, and iron. For these the Dutch give in exchange, agates of a longish form, rings of red agate, different kinds of coral; all sorts of Chinese articles, such as coarse porcelain, red and other kinds of silk; all sorts of cotton cloth, clothing such as is worn by the Indians, various productions of Java, and also opium: but the last must be introduced privately, as the use of it has been strictly prohibited by the sultan.

Succatana lies in  $0^{\circ} 50'$  south latitude. A little further north is the river Pontiana, which, through a great many mouths, discharges itself into the sea under the line. This river at its mouth is twelve feet in depth, and at high water sixteen, so that sloops and small vessels can proceed to the company's factory with great ease. The passage from the mouth of the river to the factory requires twelve hours. At the distance of seven or eight miles from its mouth, the river divides itself into two branches; the southernmost of which flows through the country governed by Pangerang Josep, who in 1778 was raised by the East India company to be sultan of Sasango and Pontiana, under the name of Sarief Abdulla Rachmann. These two kingdoms extend a great way into the country. One of the servants of the company saw at the court of this sultan, one of his vassals, the king of Gascaro, whose dominions lay at the distance of upwards of a hundred miles; and he was told that in that country there had been found some pillars, three feet in height and three in breadth, inscribed with European characters. If this information be correct, the Europeans at some early period must have penetrated a considerable way into the interior parts of the island. The Society of the Arts and Sciences at Batavia had hopes of obtaining a copy of these inscriptions, by which means the mystery might have been explained; but hitherto they have been disappointed.

Pontiana and Sasango produce excellent gold, wax, birds-nests, pearls, sago, diamonds, tin, and iron, which are bartered for provisions of all kinds and cotton cloth, but particularly rice and salt. Heavy rains, accompanied with thick clouds, prevail here from the month of November till May.

It deserves to be mentioned, as a meteorological observation, that the thermometer here is never lower than  $82^{\circ}$ , and never higher than  $94^{\circ}$ .

Landac lies on the northern arm of the river Pontiana, about seventeen miles higher up, in the latitude of  $0^{\circ} 35'$  north. The Dutch had a resident here so early as a hundred and fifty years ago. After that period their possessions were destroyed, till the king of Bantam, to whom Landac and Succatana had for many years belonged, made a present to the company of all these lands in the year 1778—but whether voluntarily or through compulsion I cannot venture to say. This much, however, is certain, that the Dutch after that time considered these lands as their property, and the princes who govern in them as their vassals; built their fort at Pontiana, between Landac and Succatana, and appointed Pangerang Saidja Nata as regent of the whole district.

The residence of the prince of Landac is situated on the projecting corner of a mountain, to which there is an ascent by 118 steps. Two rivers, which are so full of rocks that no kind of vessel can be navigated in them, flow on the right and left of this mountain; and as there are other mountains on each side of these rivers, this place is so strong by nature that it is impregnable. It is also well furnished with artillery: besides several small cannons, there are in it two iron guns, eight-pounders, one of which has on it the company's arms, and the other the Danish. It is inconceivable how such heavy masses could have been conveyed to the summit of so steep a rock. In this kingdom there are gold and diamond mines of considerable importance.

Between Landac and Borneo, the most northern kingdom of the island, and from which, in all probability, the whole country takes its name, there are several smaller kingdoms, which are not of great importance, but which are not yet sufficiently known. Their regents are, in part, vassals of the sultan of Borneo. A small trade is carried on in these districts with gold, diamonds, canes, wax, and other articles of the like kind, which are given in exchange for the productions of Java; but this traffic is of little consequence, and at

the same time uncertain, because this part of the country is inhabited by several discontented princes who live by piracy.

Borneo is governed by a sultan, who has his residence in this place, where a considerable trade is carried on with the productions of the country, which are pearls, birds-nests, wax, slaves, rice, and camphor. The camphor of this island is considered as the best, and is preferred even to that of Sumatra. Houittyn, a physician of Amsterdam, to whom natural history is so much indebted, and who, in the Transactions of the Society of Haarlem\*, has given a description with figures of the camphor-tree from the dried branches, transmitted to him by a member of the Society of the Arts and Sciences at Batavia, says: "The camphor of Borneo and Sumatra is produced by a tree with oval, sharp-pointed leaves and large tulip-like flowers. By these marks it is distinguished both from the camphor-tree of Japan, and from the other species of the laurel. A hundred weight of the camphor of Borneo costs 3000, and one of that of Sumatra 2000 rix-dollars, but the Japanese costs scarcely fifty: the last, however, is much more volatile than the other kinds." Of the camphor of Borneo about 4375 pounds are exported every year. The articles imported are tin, cotton cloth, and all the productions of Java except rice, which is cultivated here in great abundance.

The sultan of Borneo lives in great state, and is more feared by his subjects than that of Banjer; but at the same time, according to the account of some Englishmen who frequent this part of the coast with small vessels, and carry hither cotton cloth, which they exchange for pepper, he is more constant in his friendship and truer to his engagements.

Between Borneo and Tidor lie the two small kingdoms of Balangan and Baraoou, where birds-nests, wax, &c. are exchanged for Javanese productions and a sort of coarse cotton cloth. Next comes Dannuar, which is subject to a Dato called Feginda; and a little further, Sammunta, under Dato Tomongong; and Cottie, which is governed by a sultan named Adgie Umut. Between the two last there are a

\* Vol. XXI.

great many villages, the names of which are unknown. The same articles are exported and imported here as at Borneo. The next place is Appar Karrang, governed by the sultan Thua; and then Passier, the last kingdom, which belongs to the sultan Annom. The articles of trade in this country are gold, birds-nests, wax, and canes, which are exchanged for the productions of Java. The inhabitants of Passier are very few in number, and therefore it has not been possible for them to drive back the Buginese, who have made themselves masters of the river, and at the same time of the trade.

Further south lies Simpanahan, which is governed by Pangerang\* Prabo. The whole country from this place to the extreme boundaries of Salatang belongs to the king of Banjermassing, who possesses also the great and small island of Pulu-Lauts. There appear to be no other kingdoms in the interior part of Borneo; at any rate, if there are, they are not known. The inhabitants of the mountains bring the productions of their lands, and their different articles of manufacture, to the nearest part of the coast for sale.

I shall now lay before the reader what I have been able to learn respecting the Biadjoos or Dajakkefe, who for the most part inhabit an extensive district in the interior part of the country on the west side of the river Banjer. The Biadjoos are of large stature and well built. Their women are said to be fair and handsome; but they never bring them to Banjer, or any other of the places where they trade. The dress of the Biadjoos has a great resemblance to that of the Malays. Their women, and even the wives of their princes, go naked to the middle, and in general have nothing around their body but a short gown. The men paint their bodies with figures of various kinds, as is the case among the other natives of the island and throughout all India. They come to Banjer to sell their gold, canes, and rice, for which they receive in exchange coarse Chinese porcelain, copper and earthen vessels, or tampayangs, on which are represented dragons, snakes, and other figures suited to their taste.

Their marriages are accompanied with some very singular

\* Pangerang, dato, kiey, r deen, and other terms of the like kind, are words which express different degrees of dignity.

ceremonies.

ceremonies. When a bachelor has conceived an attachment for a young woman, he employs some female to ask her in marriage from her parents; but he is sure of receiving a denial unless he has given a proof of his courage by cutting off the head of an enemy. If his offer is accepted, he carries to his bride a present, which consists of a male or female slave, two dresses, and a water-pot, on which some of their favourite figures are represented. When the wedding-day arrives, the bride and the bridegroom each give an entertainment at their houses; at the conclusion of which the bridegroom, in his best apparel, is conducted to the residence of the bride, where he finds at the door one of her relations, who smears over him the blood of a cock which has been killed for that purpose; and the same ceremony takes place in regard to the bride, with the blood of a hen. They then present to each other their bloody hands; but it is considered as a bad omen if the blood, in consequence of this joining of hands, sprints out too far around them. The new-married couple then remain together, and the whole solemnity ends with a second entertainment. When the wife lies-in, the husband assumes the office of nurse, and no other care is usual on this occasion than that one of their conjurers, whom they call *balian*, gives the newly-delivered woman some medicines, amidst singing, and beating on certain instruments named *gindang*. If the wife die, the husband cannot enter again into the married state until he has cut off the head of some individual of another nation, and thereby avenged the death of his wife.

When a Biadjoo dies, the body is put into a coffin, and kept in the house until all the remaining males of the family, father, son, and other near relations, have purchased a slave; who is to be beheaded on the day when the body is burnt, in order that he may attend the deceased in the other world. Before this unfortunate wretch is butchered, it is earnestly recommended to him to be faithful to his master on the other side of the grave. The ashes of the burnt body are afterwards collected in one of the above-described water-pots, and the pot, together with the head of the slave who has been strangled, is deposited in a small edifice or tomb built for that purpose. A year often elapses before the relations of the

the deceased are in a condition to purchase a slave to serve him in the next world.

Their houses are constructed of boards joined together, and have neither windows nor partitions except that which separates a small corner for sleeping in. The whole family reside together along with their slaves, forming in the whole sometimes a hundred persons. They have nothing to afford them light but a thin piece of pine-wood, which burns no longer than till about eight in the evening. Over their doors they suspend the heads which they cut off in their skirmishes, and often while they are still bloody. Whenever they conceive a desire of displaying their courage by cutting off heads, they set out on an expedition for that purpose. On such occasions, the person who wishes to gratify his bloody intention makes known his design to his friends and relations, who deliberate with him on the means to be pursued, and who accompany him, together with their dependants and slaves. They then proceed, in great secrecy, to the river Banjer, and lie in wait for some small vessel belonging to Banjer fishermen, whom they either surprise in the night-time or attack and carry away in the open day. One or perhaps two of these unfortunate captives are then destined to become a sacrifice to their insatiable rage for murder.

When the Dajakkefe bring home a head, the whole village, men, women, and children, testify their satisfaction by every demonstration of joy. People who beat on gongs \* are stationed in a row in the street to conduct the conqueror, with the head in his hand, to his own house, where he is received by all the women present, who dance around him. When he approaches the door, he finds where the gongs cease a cushion placed for him, on which he sits down, and where the head is taken from him by the women. The fortunate head-hunter receives presents from all the company, who dance and afterwards partake of a repast. At the same time some food is thrust into the mouth of the head, and a little drink is poured into it; after which it is hung up as a perpetual trophy of victory.

\* The gong is a kind of musical instrument of copper.

These people, however, before they undertake expeditions of this kind in quest of Banjeresé heads, always endeavour to deduce some omen of good or bad fortune from the flight of a kind of hawk\*. With this view they entice the bird to perch on the ground, by strewing rice on it, and by other means; and if he wheels round when he rises, and disappears in the clouds, or flies towards that quarter to which they intend to proceed, they consider it as a sign of good fortune, and they set out with fresh courage: but if the bird directs its flight towards a quarter opposite to that to which they wish to go, they defer the expedition till a more favourable opportunity. It often happens that they must wait two or three days before such a feathered prophet appears to inform them when they are to expect good fortune.

The Biadjoos have scarcely any form of government, and no written laws. If a person is accused of theft, and if sufficient proof cannot be adduced against him, the culprit and the accuser are carried before one of the oldest inhabitants. An earthen pot with ashes and water is placed on the ground, and a bit of wood, on which are deposited two small copper buttons, is laid across the pot. After an oath has been administered to each of the parties, the bit of wood is turned round in such a manner that the buttons fall into the water; the accused and the accuser must then each draw one of the buttons from it, and he whose button appears as if scoured, and rendered white by the ashes, gains the process.

It is said that the Biadjoos have some idea of a Supreme Being, to whom they address prayers under the name of Dewatta; and as they believe that this Dewatta not only created, but still preserves and rules the world, they request him to grant them happiness and prosperity. Respecting the notions which they entertain of this deity, and the particular worship they pay to him, I can give no further account. If we may judge from the character of these people, their deity must be a gloomy and revengeful being: no nation on the earth have a greater propensity to murder and revenge.

When a married woman commits adultery, and is dis-

\* Falco Milvus.

covered by her husband, the latter never makes any attempt against the adulterer, but contents himself with putting to death two or three of his slaves; after which he imagines himself freed from all shame. The woman, on the other hand, is punished merely with words, but sometimes with blows. Do not a people, whose conduct is regulated by such laws, deserve pity? Revenge, superstition, avarice, and a spirit of plundering, are often among civilised as well as uncivilised nations the strongest incitements to acts of cruelty and murder: but the Biadjoo, who attacks only poor defenceless beings, and carries about their heads as trophies of his courage; who never attacks his enemy himself, but endeavours to be avenged by putting to death innocent slaves, certainly surpasses in cruelty the ravenous animal that devours others only to appease its hunger. Let us hope, for the honour of humanity, that a good deal in this imperfect relation may be exaggerated.

The Biadoos are unacquainted with polygamy. When a man wishes to separate from his wife in consequence of her having been guilty of some crime, he retains her clothes and ornaments, and causes her to pay besides a fine amounting to about thirty rials. After this, each party may again marry. These people acknowledge the sultan of Banjer as their sovereign, and pay him yearly a small tribute in gold dust of the value of twenty rials.

The principal part of our information respecting these people was obtained from a Mr. Palm, who made a journey from Pontiana to Landac in the year 1779 on business of the Dutch East India company, and who, on this occasion, penetrated a considerable way into the country. At Landac he paid a visit to the gold and diamond mines, and on his return had the good fortune to get into his possession an orang outang of the largest kind, which is properly a native of this island. As this animal has been described in the Transactions of the Society for promoting the Arts and Sciences at Batavia, I shall say nothing further of it \*, and

\* For a description of this animal from the above Transactions, see the Philosophical Magazine, Vol. I. p. 225.

proceed to give the reader some account of the diamond and gold mines.

In working the diamond mines great care is required to examine the ground intended to be dug. The places where diamonds are to be found may be known by certain small flints, generally of a black colour, which lie on the surface, and also by the yellow colour of the stony soil. The surest method, however, is to follow the directions of the people who reside in the neighbourhood of these mines, and to whom superstition ascribes the same wonderful power as the so called divining-rod of the Europeans was supposed to possess formerly. It is said that at certain periods of the day, such as four o'clock in the morning, twelve at noon, and four in the afternoon, they have the faculty of seeing the reflection or shining of the diamonds through the earth. These mountaineers point out to the diamond-miners a certain spot where they ought to dig; but they receive no payment till it actually appears that it contains diamonds. A pit about six feet square is then made in the place with a kind of pick-axe, for in such stony ground shovels and spades cannot be employed. The earth when loosened is taken up in baskets, formed into heaps, and afterwards sifted by people, who sit in water-pits dug for the purpose, first with coarse and then with finer sieves. The remaining sand is then washen with the water, amidst which the labourers sit and examine it once more. If nothing is found, the stones and earth are thrown on one side; but if any diamonds appear, the overseer, who is always present, watches with great care till the good stones are collected and formed into a heap. The workmen receive but very moderate pay for their labour. All those stones that weigh above five carats must be immediately delivered to the sovereign prince or the sultan. But this law is made only for the simple, as nothing is easier than to swallow such stones, and in that manner to carry them away.

The mines are dug, in a perpendicular direction, sometimes to the depth of ten fathoms. The labourers, however, are totally unacquainted with the art of mining, and therefore when the least difficulty occurs they are entirely at a loss. The sides of the pits are prevented from falling in by bundles

bundles of rice-straw and pieces of wood placed in a cross direction; but such accidents often happen, particularly in the time of violent storms. As they are incapable of freeing the pits from water during heavy rains, they are prevented from working, and must suspend their labour till the weather becomes dry. The most productive diamond mines are at Ambauwang, beyond Molucco, in the district of Banjermassing, and at Landac and Pontiana. Besides these mines, which lie among the mountains, diamonds are sought for also on the banks of various rivers; but those who follow this occupation have so little success, that ten or twelve men will dig and search sometimes a whole month before they find diamonds to the value of twenty Spanish rials.

In regard to the gold mines, the ignorance of the natives respecting every thing that relates to mining is so great, that little advantage is derived from them, though they are supposed to be very rich. In Banjermassing the gold is found at the depth of about three fathoms; the veins properly so called are of a reddish kind of marl. At Landac the ore is found at the depth of about ten feet, and the workmen must dig till they come to a crust which has almost the appearance of rotten wood. Until this vein, which is called the covering of the mine, be found, there are no hopes of meeting with gold.

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*II. Method of preserving Birds and small Quadrupeds by means of Ether. By C. CHAPTEL.*

**T**HIS method of preparing all kinds of animals for cabinets is exceedingly simple, and so certain in its effect that C. Chaptal never found it to fail in a single instance. It is as follows:—The matter contained in the bowels of the animal must be evacuated, either by gradually pressing the body towards the rectum, or by injecting some liquid which may remove every thing that stands in its way. After this operation, the end of the rectum is to be tied with a thread, and ether to be injected, with a proper instrument, into the body through

through the mouth or bill; and when the bowels have been filled with it, the animal is to be hung up by the head. One of the eyes must then be scooped out, and the brain extracted: after which the head is also filled with ether, which must be prevented from escaping by plugging up the eye-hole. On the second or third day the injecting of ether is to be repeated, and this process is to be continued till the animal be completely dried.

While the animal is gradually drying, care must be taken to give to the body its proper position, and as soon as it is completely desiccated it may be put up without further care or any other preparation. A small female papajay, prepared according to this method in the year 1782, was lost behind the shelves of a library, and remained there two years without its solidity or form being in the least changed. This process for preserving animals seems to be attended with considerable advantages. C. Fouchy, of Montpellier, says C. Chaptal, who has made ornithology his particular study, recommended spirit of wine, a few years ago, for the same purpose; but as soon as the spirit of this liquid has evaporated, the remaining aqueous part promotes corruption in a very great degree; whereas ether, by its evaporation, carries with it not only its own aqueous particles, but those also which it absorbs from the body. Besides, this method neither destroys the form of the animal nor tarnishes the splendour of the feathers or hair, and is exceedingly cheap: one ounce of ether is in general sufficient for a small bird. A large papajay required only one ounce and a half. As the process is attended with so little expence, it may be used for animals of a considerable size.

C. Chaptal remarks, that in regard to animals which have been wounded, and on that account have apertures in their bodies which cannot be shut so well as the natural apertures, the process is more difficult, and attended with greater trouble, as they are less capable of containing the ether. Such animals, therefore, must be chosen for preservation as have died a natural death, or as have been killed by being strangled. The process will be performed sooner or more slowly accord-

ing as the weather is more or less favourable for drying the body. The process of drying might perhaps be a little shortened by the application of artificial heat.

The theory of this process, as C. Chaptal thinks, is, that the ether, while it evaporates, volatilises the moisture in the animal body, by these means effects a gradual desiccation, and thus removes the only cause of corruption.

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### *III. Description of a new Instrument for Trepanning, invented by Mr. JOHN RODMAN, Surgeon in Paisley. Communicated by the Inventor.*

THE operation of trepanning must be considered a very important one in surgery, both on account of the dangers with which it is often attended, and the beneficial effects which follow the successful performance of it. The danger and accidents which attend this operation arise partly from the imperfection of the instruments employed, and partly from want of dexterity in the operator.

To manage the instruments now in use for trepanning with neatness and facility, would require a degree of mechanical dexterity which falls to the lot of few surgeons: yet surgeons the most inexperienced, and unaccustomed to operations of any kind, are often necessarily called upon to perform this operation.

The trepan is allowed by the greater number of surgeons to be a dangerous instrument, and the use of the trephine, though more generally employed, has been sometimes followed by fatal accidents.

The chief objection to the more general use of the trepan seems to arise from the chance of its passing suddenly in upon the brain towards the end of the operation. To avoid such an accident, the celebrated professor of anatomy at Edinburgh says, in his lectures, that it might be as well to begin the operation with the trepan, and to finish it with the trephine. But, whichever of these instruments be employed, there is still a risk of the bone being unequally cut: for, if the instrument be held in the smallest degree to one side during the operation,

tion, the bone at that side to which it is most inclined will soonest give way, and consequently the brain may be injured before the surgeon is apprised of it. Such accidents, it is well known, have frequently happened. Sometimes, too, the centre-pin, from agitation or inattention of the surgeon, has been left in the instrument to the end of the operation, and, after passing through the bone, has perforated the brain.

Besides these, and several other obvious objections, the number of necessary auxiliary instruments sufficiently evinces the propriety of attempting to simplify and improve the present mode of operating.

The manner of perforating the skull by the instruments now in use is, first, with the perforator, to make a small hole in the bone of a sufficient depth to receive the centre-pin of the saw, then to apply the instrument, and to continue sawing till the groove is deep enough to preserve the instrument steadily without the centre-pin: the instrument then is withdrawn, and the pin removed by means of the key. The surgeon now proceeds to finish the operation, and, having replaced the instrument, works through the bone with the greatest caution, taking care to withdraw and replace the instrument from time to time, in order not only to clear away the dust that fills up the teeth of the saw, but to discover whether the portion of bone to be removed is nearly separated.

By this way of operating it is evident a considerable portion of the time is taken up even in preparing for the operation, beside what is lost during the course of it. To save time in this, as in every other operation, must be considered as a matter of great consequence both to the patient and surgeon. With a view to show how this may be accomplished, it will be necessary to mention in what manner the operation may be conducted with the instrument now to be proposed.

The patient being prepared for the operation, and the instrument applied, as in the plate, care must be taken to make the sawing-teeth round the whole circumference touch the surface of the bone equally. This can easily be done; for, though the inequality of the bones on which the instrument is placed be such as to prevent the saw from acting on all points

points of the circle alike, one or other of the legs may be lengthened or shortened at pleasure, by means of the setting screws; and in this manner it may be made to fit exactly.

The next step of the operation is, to cut the pericranium with one or two turns of the instrument, and, if necessary, that portion of the membrane within the circle of the saw may be removed with the fingers. The sawing is now begun by turning the handle with one hand, and holding the instrument firmly with the other. Thus the bone may be cut very quickly; and if the surgeon wish to proceed cautiously towards the end of the operation, he may then work the instrument in the manner of the trephine, which can be done by grasping the handle with one hand, and supporting the frame as before mentioned.

The simplicity of the instrument, and the mode of operating with it, will be better understood by the following description:

A, A, the handle, (Plate VII;) B, B, the axle, passing through D, the upper part of the frame; and C, the cross-band. E, E, E, the sides of the frame; F, F, F, the feet or rests, which slide in the sides of the frame K, K, K, and are fastened with thumb-screws *b, b*; G, the cutting-head, fixed on the end of the axle; H, a collar which slides upon the axle, and can be made fast upon it with the thumb-screw *a*.

The sliding-collar may be used with advantage when the surgeon is afraid of plunging the head of the instrument into the brain during the operation; for, by fixing it at a certain distance above the cross-band, it will rest upon it, sooner or later, according to the intention of the operator, and prevent the instrument from passing deeper until the collar be shifted. For this reason, as well as the superiority of the instrument in general to those in common use, it is particularly recommended to surgeons who may have frequent occasion to perform this operation on board a ship at sea.

**IV. Observations on the Economical Use of the Ranunculus aquatilis; with Introductory Remarks on the acrimonious and poisonous Quality of some of the English Species of that Genus.** By RICHARD PULTENEY, M.D. F.R.S. and L. S. \*

BOTH ancient and modern writers on Botany and the *Materia Medica* agree, pretty uniformly, in attributing to many species of the genus *Ranunculus* a corrosive and poisonous quality. In several it abounds in such a degree as, when applied externally, in a recent state, to excite vesications, and ulceration of the parts, frequently of a malignant and gangrenous nature; and, when taken inwardly, to prove poisonous and fatal, by inducing vomiting, inflammation of the stomach, with the usual consequences of acrid poisons. These qualities are particularly manifest in the recent plant, while in its highest vigour before flowering; and more intensely in the germen of the flower itself, and in the petals of some,

The poisonous species, that are indigenous, and common in England, are, the *Ranunculus Flammula*, or Lesser Spearwort; *R. bulbosus*, bulbous-rooted Crowfoot; *R. acris*, upright Crowfoot; *R. sceleratus*, Marsh Crowfoot; *R. arvensis*, Corn Crowfoot; and the *R. aquatilis*, or Water Crowfoot, according to the report of various authors. Of these the *Flammula*, *bulbosus*, and *sceleratus*, are judged to be the most acrimonious.

Before the introduction of *Cantharides*, the acrid *Ranunculi* were, all in their turn, used as vesicatories; and Haller tells us †, the *R. Flammula* is still in use as such in some parts of France. Gilibert assures us ‡ that the *R. bulbosus* vesicates with less pain than the *flies*, and has no effect on the urinary

\* From the *Transactions of the Linnaean Society*, Vol. V.

† See the *Enumeration Stirpium* and *Historia Stirpium Helveticæ*, in which much satisfactory information is collected respecting the properties of this genus of plants; and for which the author has, with his usual candour and accuracy, quoted all his authorities.

‡ *Plantæ rarioræ Lithuaniae*, No. 33.

passages.

passages. He gives it therefore a decided preference as an epispastic. Other authors allow these qualities in the *Ranunculi*, and that they are quicker than *Cantharides* in their vesicating effect; but say, that all these advantages are more than balanced by the greater uncertainty of their action on the skin, and their frequently leaving ill-conditioned ulcers, of which Murray and other writers have recorded instances\*. Nevertheless, the *Ranunculi* were employed in local spasmodic complaints and in fixed pains, and not unfrequently in cataplasms to the wrists in intermitting fevers. *Crowfoot* is known also to have been one of the ingredients in Plunket's epithem for cancers.

The acrimony of these plants is, however, of so volatile a nature, that, even in the most virulent, it is wholly dissipated in drying; so that, in the form of hay, they appear to be harmless, and nutritive to cattle. It is also instantly expelled in decoction, probably in all the species; at least, Murray informs us, that the shepherds of Morlachia eat even the *R. sceleratus*, as a culinary plant, after boiling it: the *R. auricomus*, and, as several authors assure us, the *R. repens*, are so destitute of acrimony as to be wholly inoffensive, and even worthy of a place among oleraceous plants.

The *Ranunculi* give out this quality wholly in distillation: the water of the *R. sceleratus*, by the experiments of Tilebein, as recorded in the second volume of the *Chemical Annals*, is acrimonious in an intense degree, and, when cold, deposits crystals which are scarcely soluble in any menstruum, and are of an inflammable nature †. The distilled water of the *R. Flammula*, or Lesser Spearwort, as we are informed by Dr. Withering, is an emetic more instantaneous, and less offensive during its action, than white vitriol; and, as if Nature had furnished an antidote to poison from among poisons of its own tribe, is to be preferred in promoting the instant expulsion of deleterious substances from the stomach.

In the experiments of the *Pan Suecus*, even in the improved edition by Schreber, after the observations and renewed trials of Kalm, Gadd, Bergius, and Lastbohm, made upon horned cattle, goats, sheep, horses, and swine, all the

\* *Apparat. Medicam.* iii. 87.

† *Page* 313.

species of *Ranunculi*, with which trials were made, except the *R. auricomus*, were rejected by the horned cattle; and it is well known, that while our meadows and pastures are eaten bare of other vegetables, the *R. acris* and *R. bulbosus*, which are but too plentiful, are left untouched: neither do cattle willingly eat the *R. repens*, although it is not wholly rejected by horses, sheep, and goats.

The *R. Flammula*, according to the above experiments, was eaten only by horses, to which animal it is there said to be very grateful; whereas the *R. auricomus*, eaten by all the rest, (except that swine choose only the roots,) was rejected by horses. The *R. sceleratus*, which is supposed to be the *Herba Sardonia* of Dioscorides, was touched by goats alone; the *R. bulbosus* only by the latter, though it is well known in England that hogs are fond of the roots. The *R. acris* was eaten by sheep and goats; but the *R. aquatilis* is recorded as the only one rejected by all the five species of animals on which these trials were made. It does not appear by either edition of the *Pan Suecus*, that any trials were made with *R. arvensis*; and though horned cattle and horses will eat this species greedily, (although not without subsequent injury,) yet it is known to have been highly deleterious to sheep. A notable instance of this occurred in Piedmont in the year 1786, where a number of these animals died, as it was at first supposed, of an epidemical disease; but subsequent examination discovered that this destruction was owing to the *Ranunculus arvensis*. The history of this accident is circumstantially related in the Memoirs of the Royal Academy of Turin, by M. Brugnon \*. The herb grows luxuriantly in Piedmont, and the sheep fed with much eagerness upon it. The effects here mentioned were not immediate, but progressive; and M. Brugnon, on further investigation, was convinced they were principally owing to the roots of the plant; since, by experiments purposely made on dogs, these animals were almost instantly killed by them. On the dissection of the sheep, all the four concoptive organs were found affected with erysipelatous and gangrenous spots;

\* Mémoires de l'Académie Royale des Sciences, Années 1788—1789,  
à Turin. 4to. 1790.

but more particularly the *abomasum*, which he found much more deeply ulcerated than the others; and the mischief had extended into the smaller intestines.

The avidity with which sheep, horses, and cows, eat the *Ranunculus arvensis*, is, as M. Brugnon justly observes, an exception to the commonly received maxim, that herbivorous animals are, by instinct, led to reject whatever is noxious. We see frequently that hunger will impel our domesticated cattle, especially on being first turned to grass in the spring, to eat almost all vegetables promiscuously. Some of our farmers are aware of the effects of *Crowfoot*, of which the *R. acris* and *R. bulbosus* are so common in our pastures, and by which the mouths of their cattle are frequently inflamed and blistered; and doubtless the effects often extend much further, and sometimes prove fatal. There can be little doubt of the same destructive consequences from other poisonous plants, in cases where the cause is little suspected.

M. Krapf, who instituted a set of experiments wholly confined to this genus of plants \*, attributes to the *R. aquatilis* the deleterious qualities belonging to the others; observing, that it will vesicate the skin, but is slower in its operation than the *R. bulbosus* and *R. sceleratus*. Bishop Gunnerus also, in his *Flora Norvegica* †, tells us, that this species is not less noxious to cattle than the *R. sceleratus*; that even the goat, an animal less nice in the selection of its food than the others, leaves it wholly untouched.

It is well known to botanists, that the *Ranunculus aquatilis* of Linnæus comprehends four species of the older writers; and even Haller, and some more modern authors, still keep them separate: among whom, the late professor Sibthorp, in his *Flora Oxoniensis*, enumerates them distinctly, under the names of, 1. *R. heterophyllus*, or *R. aquatilis Ger. em.* 829. *Ray Syn.* 249. 2. *R. aquatilis*, or *R. aquatilis omnino tenuifolius J. B. iii. 781. Ray Syn.* 249. 3. *R. circinatus*, *R. aquaticus albus*, *circinatis tenuissime divisis foliis, floribus ex aliis longis pediculis innixis Plak. alm. 311. t. 55. 2. Ray*

\* C. Krapf, *Experimenta de nonnullorum Ranunculorum venenata qualitate, horum externo et interno usu. Vienne 1766. 8vo. p. 107.*

† No. 646.

*Syn. 249.* and 4. *R. fluviatilis*, or Ranunculo five Polyanthemo aquatili albo affine, Millefolium maratriphyllum fluitans. *J. B.* iii. 782. Without entering here into any disquisition relative to these distinctions of the species, I shall come to the ultimate object of these observations, by remarking, that I was lately witness to a fact, with respect to the *Ranunculus aquatilis fluviatilis*, which, after what I recollect of the character of the plant, somewhat surprised me, while it sufficiently proved, not merely the innocuous quality of this plant, but that it is nutritive to cattle, and capable of being converted to useful purposes in agricultural economy. Unless these varieties of the *R. aquatilis* Linn. be endowed with different properties, it is a proof that the experiments on this plant were not made with sufficient accuracy, or discrimination of the varieties; not sufficiently repeated on different individuals of the same species of animals; or, that in different countries or situations it is divested of its virulence. In the present instance, it is probable, the plant is rendered inert as a poison, by growing in the water; although in certain other instances, moisture is thought to heighten the deleterious property of vegetables, especially in the umbelliferous tribe.

The fact that I have alluded to is, that in the neighbourhood of Ringwood, on the borders of the Avon, which affords this vegetable in great abundance all the year, some of the cottagers sustain their cows, and even horses, almost wholly by this plant; since the remaining part of their food is nothing more than a scanty pittance they get on the adjacent heath, which affords little more than *Ling*, *Lichen*, Bog-moss or *Sphagnum*, &c. It is usual to employ a man to collect a quantity for the day every morning, and bring it in the boat to the edge of the water, from which the cows, in the instance I saw, stood eating it with great avidity. I was indeed informed they relished it so highly, that it was unsafe to allow them more than a certain quantity; I think between twenty-five and thirty pounds each, daily; but with variation according to circumstances. The cows I saw were apparently not in a mean condition, and gave a sufficient quantity of good milk. I was told by the person whose cattle

were feeding on it, that he kept five cows and one horse so entirely by this plant, and what the heath afforded, that they had not consumed more than half a ton of hay throughout the whole year; none being used, except when the river is frozen over. I examined the whole parcel, on which four cows were feeding, in the beginning of March, and found the whole consisted, exclusively, of the *Ranunculus fluvialis*, without any mixture of the *Potamogeton*, *Carex*, *Sparganium*, or other aquatic plants. In summer, however, it can scarcely be avoided but that there must be a mixture of some of these: but other plants are not chosen.

This account was confirmed to me by different persons; by whom I was further informed, that hogs are also fed with the same plant, on which they improve so well, that it is not necessary to allow them other sustenance till it is proper to put them up to fatten..

This relation, while it shows how carefully experiments should be conducted before a decisive judgment on the powers of any reputedly poisonous vegetable can be formed, may induce such as were unacquainted with this fact to adopt the use of this plant in similar situations, since it is one of the most frequent in many rivers of this kingdom. The application of it to these useful purposes will also answer a secondary good—of tending to clear the streams of what is otherwise considered as a noxious weed; since, by its abundance in summer, it is frequently seen to choke up the rivers more than any other plant, and, from slight falls of rain, contributes much to the overflowing of meadows in hay-time.

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V. Description of the *Mus Bursarius*, from a Drawing communicated by Major-General Thomas Davies, F. R. S. & L. S. By GEORGE SHAW, M. D. F. R. S. V. P. L. S.\*

THE *Mus bursarius* belongs to a particular division in the genus, containing such species as are furnished with cheek-pouches for the temporary reception of their food. It seems not to have been yet described, or at least not so

\* From the *Transactions of the Linnean Society*, Vol. V.  
distinctly

distinctly as to be easily ascertained. It approaches however to one or two species mentioned by Dr. Pallas, Mr. Pennant, and others; but differs in size, being much larger, as well as in the appearance of the fore-feet, which have claws differently formed from any of the pouched species hitherto described.

In order to secure its knowledge among naturalists, it may be proper to form for it a specific character, *viz.*

*Mus cinerens, caudâ tereti brevi subnudâ, genis saccatis, unguibus palmarum maximis fossoriis.*

Ash-coloured rat, with short, round, nearly naked tail, pouched cheeks, and the claws of the fore-feet very large, formed for burrowing in the ground.

The cheek-pouches are far larger, in proportion to the animal, than in any other of this tribe, and therefore have given occasion for the specific name. (Plate VIII.)

This quadruped was taken by some Indian hunters in the upper parts of Interior Canada, and sent down to Quebec. It is now in the possession of Governor Prescott.

VI. *On the Analysis of Azot: an Extract of a Letter from Dr. GIRTANNER to Dr. VAN MONS of Brussels\**.

Gottingen, Dec. 26, 1799.

I HAVE been travelling during the greater part of the summer for the restoration of my health. I spent some time in Switzerland, where I met with one of my old friends, an excellent chemist. We repeated, amidst the thunder of cannon, a great number of the experiments I had made on the analysis of azot; and I can now prove that this substance is a compound body. The experiments of Wiegbleb and Wurzer are true, whatever the Dutch chemists may say to the contrary; but these experiments, as you may readily conceive, prove nothing against the theory of Lavoisier. I have written a memoir in French on the analysis of azot, which I should send you to be inserted in the Annales, were I certain that it would not be lost by the way.

I am now publishing the third edition of my Principles of

\* From the *Annales de Chimie*, No. 99.

the Antiphlogistic Chemistry, in which you will find new ideas on the acidifiable base of the marine acid. I am certain it is hydrogen; but the acid contains much less oxygen than water.

That I may not leave your curiosity ungratified in regard to the analysis of azot, I must tell you, that it is composed of hydrogen and oxygen in the proportion of 0.21 of the former, and 0.79 of the latter : it is nothing else, therefore, than an oxyd of hydrogen. All our eudiometry is false, since azot is a production of our eudiometric analysis, and did not exist in the air before the experiment. Alumine or argillaceous earth is the substance most proper for changing atmospheric air into azotic gas. This is the principle on which the production of saltpetre, so much sought after in France at the commencement of the war, depends, and which is now discovered by my experiments.

Hydrogen gas may be transformed into azotic gas by respiration: the oxygen gas, a part of which is always condensed in the lungs, joins itself to the hydrogen, and changes it into azot. The same conversion may be effected, and in a much more sensible manner, by bringing hydrogen gas into contact with moistened argil.

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VII. *Description of the Method employed at Astracan for making grained Parchment or Shagreen.* By Professeur PALLAS.

THE process for preparing shagreen is a very old oriental invention, not practised in Europe, and which, as far as I know, has never yet been described; though Basil Valentin †

\* In our last we announced this discovery of Dr. Girtanner, and gave Dr. Van Mens's letter to C. Delametherie upon the subject, by which the proportions were stated to be hydrogen 93, and oxygen 7. We are inclined to think the present is the result obtained by later experiments, as the former was copied from the *Journal de Physique* for Nivose, which answers to the end of December and 21 days of January. EDIT.

† See M. B. Valentini Museum Muscorum oder Vollständige Schaubüchne aller materialien und specereyen, p. 439.

is pretty right in what he says of it in general. It is one of those arts of the East, which, like that of the Turkey dye for cotton, the preparation of Russia leather, ifinglass, &c. have remained unknown and unemployed, not because they are kept secrets, but because none of the European travellers ever took the trouble to learn them, and because the materials used are not so common and so cheap in Europe. It may be of some utility, therefore, if I here give a circumstantial description of this art as it is practised at Astracan by the Tartars and Armenians, especially as the method of these people is perfectly similar to that used in Turkey, Persia, and various parts of Bucharia, and as the shagreen-makers of Astracan acknowledge that they obtained the process originally from Persia.

All kinds of horses' or asses' skin, which have been dressed in such a manner as to appear grained, are by the Tartars called *sauver*, by the Persians *sogre*, and by the Turks *zagli*, from which the Europeans have made *shagreen* or *chagrin*. The Tartars who reside at Astracan, with a few of the Armenians of that city, are the only people in the Russian empire acquainted with the art of making shagreen. Those who follow this occupation not only gain considerable profit by the sale of their production to the Tartars of Cuban, Astracan, and Casan, who ornament with it their Turkey leather boots, slippers, and other articles made of leather; but they derive considerable advantage from the great sale of horses' hides, which have undergone no other process than that of being scraped clean, and of which several thousands are annually exported, at the rate of from 75 to 85 roubles per hundred, to Persia, where there is a scarcity of such hides, and from which the greater part of the shagreen manufactured in that country is prepared. The hind part only of the hide, however, which is cut out in the form of a crescent about a Russian ell and a half in length across the loins, and a short ell in breadth along the back, can properly be employed for shagreen. The remaining part, as is proved by experience, is improper for that purpose, and is therefore rejected.

The preparation of the skins, after being cut into the above form, is as follows:—They are deposited in a tub filled with

'pure

pure water, and suffered to remain there for several days, till they are thoroughly soaked; and the hair has dropped off. They are then taken from the tub, one by one, extended on boards placed in an oblique direction against a wall, the corners of them, which reach beyond the edges of the board, being made fast, and the hair with the epidermis is then scraped off with a blunt iron scraper called *uruk*. The skins thus cleaned are again put in pure water to soak. When all the skins have undergone this part of the process, they are taken from the water a second time, spread out one after the other as before, and the flesh side is scraped with the same kind of instrument. They are carefully cleaned also on the hair side, so that nothing remains but the pure fibrous tissue, which serves for making parchment, consisting of coats of white medullary fibres, and which has a resemblance to a swine's bladder softened in water.

After this preparation, the workmen take a certain kind of frames called *pilzi*, made of a straight and a semi-circular piece of wood, having nearly the same form as the skins. On these the skins are extended in as smooth and even a manner as possible by means of cords; and during the operation of extending them they are several times besprinkled with water, that no part of them may be dry, and occasion an unequal tension. After they have been all extended on the frames, they are again moistened, and carried into the house, where the frames are deposited close to each other on the floor with the flesh side of the skin next the ground. The upper side is then thickly besprewed with the black exceedingly smooth and hard seeds of a kind of goose-foot, (*chenopodium album*\*) which the Tartars call *alabuta*, and which grows in abundance, to about the height of a man, near the gardens and farms on the south side of the Volga; and that they may make a strong impression on the skins, a piece of felt is spread over them, and the seeds are trod down with the feet, by which means they are deeply imprinted into the soft skins.

\* This chenopodium is often used as food by the German colonists on the Volga, on account of the frequent failure of their crops. They employ it either as a substitute for greens, or pound the seeds, and, with the addition of a little meal, form them into bread.

The frames, without shaking the seeds, are then carried out into the open air, and placed in a reclining position against a wall to dry, the side covered with the seeds being next the wall, in order that it may be sheltered from the sun. In this state the skins must be left several days to dry in the sun, until no appearance of moisture is observed in them; when they are fit to be taken from the frames. When the impressed seeds are beat off from the hair side, it appears full of indentations or inequalities, and has acquired that impression which is to produce the grain of the shagreen, after the skins have been subjected to the last smoothing or scraping, and have been dipped in a ley, which will be mentioned hereafter, before they receive the dye.

The operation of smoothing is performed on an inclined bench or board, which is furnished with an iron hook, and is covered with thick felt or sheep's wool, on which the dry skin may gently rest. The skin is suspended in the middle of the bench or board to its iron hook, by means of one of the holes made in the edge of the skin for extending it in its frame as before mentioned; and a cord, having at its extremity a stone or a weight, is attached to each end of the skin, to keep it in its position while under the hands of the workman. It is then subjected to the operation of smoothing and scraping by means of two different instruments. The first used for this purpose, called by the Tartars *tokar*, is a piece of sharp iron bent like a hook, with which the surface of the shagreen is pretty closely scraped to remove all the projecting inequalities. This operation, on account of the corneous hardness of the dry skin, is attended with some difficulty; and great caution is at the same time required that too much of the impression of the *alabuta* seed be not destroyed, which might be the case if the iron were kept too sharp. As the iron, however, is pretty blunt, which occasions inequalities on the shagreen, this inconvenience must afterwards be remedied by means of a sharp scraping-iron or *urak*, by which the surface acquires a perfect uniformity, and only faint impressions of the *alabuta* seed then remain, and such as the workman wishes. After all these operations, the shagreen is again put into water, partly to make it pliable, and partly to raise

raise the grain. As the seeds occasion indentations in the surface of the skin, the intermediate spaces, by the operations of smoothing and scraping, lose some part of their projecting substance; but the points which have been depressed, and which have lost none of their substance, now swell up above the scraped parts, and thus form the grain of the shagreen. To produce this effect, the skins are left to soak in water for twenty-four hours; after which they are immersed several times in a strong warm ley, obtained, by boiling, from a strong alkaline earth named *schora*, which is found in great abundance in the neighbourhood of Astracan. When the skins have been taken from this ley, they are piled up, while warm, on each other, and suffered to remain in that state several hours; by which means they swell, and become soft. They are then left twenty-four hours in a moderately strong pickle of common salt, which renders them exceedingly white and beautiful, and fit for receiving any colour. The colour most usual for these skins is a sea-green; but old experienced workmen can dye them blue, red, or black, and even make white shagreen.

For the green colour nothing is necessary but filings of copper and sal-ammoniac. Sal-ammoniac is dissolved in water till the water is completely saturated; and the shagreen skins, still moist, after being taken from the pickle, are washed over with the solution on the ungrained flesh side, and when well moistened a thick layer of copper filings is strewed over them: the skins are then folded double, so that the side covered with the filings is innermost. Each skin is then rolled up in a piece of felt; the rolls are all ranged together in proper order, and they are pressed down in an uniform manner by some heavy bodies placed over them, under which they remain twenty-four hours. During that period the solution of sal-ammoniac dissolves a quantity of the cupreous particles sufficient to penetrate the skin and to give it a sea-green colour. If the first application be not sufficient, the process is repeated in the same manner; after which the skins are spread out and dried.

For the blue dye, indigo is used. About two pounds of it, reduced to a fine powder, are put into a kettle; cold water is poured

poured over it, and the mixture is stirred round till the colour begins to be dissolved. Five pounds of pounded *alakar*, which is a kind of barilla or crude soda, prepared by the Armenians and Calmues, is then dissolved in it, with two pounds of lime \* and a pound of pure honey, and the whole is kept several days in the sun, and during that time frequently stirred round. The skins intended to be dyed blue must be moistened only in the natrous ley *scchora*, but not in the salt brine. When still moist, they are folded up and sewed together at the edge, the flesh side being innermost, and the shagreened hair side outwards; after which they are dipped three times in the remains of an exhausted kettle of the same dye, the superfluous dye being each time expressed; and after this process they are dipped in the fresh dye prepared as above, which must not be expressed. The skins are then hung up in the shade to dry; after which they are cleaned and paired at the edges.

For black shagreen, gall-nuts and vitriol are employed in the following manner:—The skins, moist from the pickle, are thickly besprinkled with finely pulverised gall-nuts. They are then folded together, and laid over each other for twenty-four hours. A new ley, of bitter feline earth or *scchora*, is in the mean time prepared, and poured hot into small troughs. In this ley each skin is several times dipped; after which they are again besprinkled with pounded gall-nuts, and placed in heaps for a certain period, that the galls may thoroughly penetrate them, and they are dried and beat, to free them from the dust of the galls. When this is done, they are rubbed over, on the shagreen side, with melted sheep's tallow, and exposed a little in the sun, that they may imbibe the grease. The shagreen-makers are accustomed also to roll up each skin separately, and to press or squeeze it with their hands against some hard substance, in order to promote the absorption of the tallow. The superfluous particles are removed by means of a blunt wooden scraper (*urak*); and when this process is finished, and the skins have lain some time, a suffi-

\* Quick-lime is probably meant here, which, by taking up the carbonic acid of the alkali, and thereby rendering it caustic, will enable it to effect a mechanical solution, or rather an impalpable comminution, of the indigo.  
EDIT.

cient quantity of vitriol of iron is dissolved in water, with which the shagreen is moistened on both sides, and by this operation it acquires a beautiful black dye. It is then dressed at the edges, and in other places where there are any blemishes.

To obtain white shagreen, the skins must first be moistened, on the shagreen side, with a strong solution of alum. When the skin has imbibed this liquor, it is daubed over on both sides with a paste made of flour, which is suffered to dry. The paste is then washed off with alum-water, and the skin is placed in the sun till it is completely dry. As soon as it is dry, it is gently besmeared with pure melted sheep's tallow, which it is suffered to imbibe in the sun; and, to promote the effect, it is pressed and worked with the hands. The skins are then fastened in succession to the before-mentioned bench, where warm water is poured over them, and the superfluous fat is scraped off with a blunt wooden instrument. In the last operation the warm water is of great service. In this manner shagreen perfectly white is obtained, and nothing remains but to pair the edges and dress it.

But this white shagreen is not intended so much for remaining in that state as for receiving a dark red dye, because, by the above previous process, the colour becomes much more perfect. The skins destined for a red colour must not be immersed first in ley of bitter salt earth (*schora*), and then in pickle, but, after they have been whitened, must be left to soak in the pickle for twenty-four hours. The dye is prepared from cochineal, which the Tartars call *kirmitz*. About a pound of the dried herb *tchagann*, which grows in great abundance in the neighbourhood of Astraeon, and is a kind of soda-plant or kali, (*salsola ericoides* \*), is boiled a full hour in a kettle containing about four common pailfulls of water; by which means the water acquires a greenish co-

\* The beautiful red Turkey leather is dyed with cochineal prepared in the same manner. Professor Gmelin junior, in the second part of his Travels through Russia, explains the herb *tchagann* by *artemisia annua*, having doubtless been deceived by the appearance the plant acquires after it has been dried. Besides, this *artemisia* is found only in the middle of Siberia, and never on the west side of the Irtisch.

lour. The herb is then taken out, and about half a pound of pounded cochineal is put into the kettle, and the liquor is left to boil a full hour, care being taken to stir it that it may not run over. About 15 or 20 drams of a substance which the dyers call *lütter* (*orchilla*) is added, and when the liquor has been boiled for some time longer the kettle is removed from the fire. The skins taken from the pickle are then placed over each other in troughs, and the dye-liquor is poured over them four different times, and rubbed into them with the hands, that the colour may be equally imbibed and diffused. The liquor each time is expressed; after which they are fit for being dried. Skins prepared in this manner are sold at a much dearer rate than any of the other kinds.

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### VIII. *On that Disease peculiar to Poland and some of the neighbouring Countries, called the Plica Polonica.*

**T**HE celebrated Professor Brera, who resided in Poland during the summer of the year 1795, and who had a good opportunity of making observations on this singular disease in the country to which it is peculiar, has published the following account of it:—“Under the term *plica polonica* is understood a disease by which the hair on the head and other parts of the body swells, becomes matted together, and forms hard knots, and, on being touched, occasions the most acute pain. The patient at the same time is seized with a kind of nervous fever, and the functions of the brain are deranged. This disease prevails throughout all Poland; but it seems to be more peculiar to Lithuania, where the inhabitants, of every age and condition, are, sooner or later, attacked by it. Sometimes it is found among the wild animals, but oftener among the domestic, and most frequently among horses. In Lower Hungary, the Bannat, Croatia, and Sclavonia, there is at present a similar disease, from which foreigners who reside long in those countries suffer more than the natives.

“The symptoms of this dreadful malady in general are, sleep disturbed by terrible dreams, a sudden depression of the spirits, and a loathing of every kind of food. A few days

days after, gouty pains are felt, sometimes in the arms, and sometimes in the knees. The disease then more and more manifests itself, accompanied with a fever, at first of a doubtful nature, but which commonly exhibits a nervous character, the affections of which still increase. The physicians, in those countries where this disease prevails, often treat it in an improper manner, and waste the time in the application of palliatives. The pains, uneasiness, and other affections, are, however, sometimes lessened by the common mode of treatment, and the patient often recovers in some measure his appetite, and might entertain hopes of a cure, did not a shivering of the whole body, and a stronger or weaker heat which follows, with violent pains and an uncommon heaviness, remind him too much of the lurking evil. Uncertain respecting the event, he wanders about for several months, and, instead of health, the disease returns with more violence than ever. The pains in the limbs become more acute, the itching in the arms greater, and the patient remains confined to his bed. The hair begins gradually to swell, and to become clammy, and a fixed pain takes place above the socket of the eye, and gradually extends over the whole forehead. The functions of the brain begin to be deranged; all objects seem to the patient to have an appearance different from what they usually have; and he is frequently seized with fits of giddiness, and even blindness. He is at the same time tormented with intolerable thirst, and experiences a violent sensation of burning in the throat, and over the whole skin. The urine is commonly turbid, almost of a coffee-brown colour, and gives a dark sediment. The body is costive.

" Under these circumstances the disease increases, and it then becomes high time to apply means for lessening, or rather removing, if possible, those affections which threaten the life of the patient. This is the critical period for bringing the disease, as the Polish physicians say, to maturity. When this is accomplished, the patient will be past all danger. The surest means of effecting this end is, to endeavour to excite perspiration; for which purpose the warm bath, strengthened with a decoction of aromatic or other herbs according to

circumstances, and which the patient ought to use every day, is to be recommended. At other times, the body must often be rubbed with flannel, in order to maintain a determination of the juices towards the skin. Diluent medicines, such as the extract of bitters, soap, hemlock, and mercurius dulcis if no scorbutic diathesis exists, are to be administered internally. It has been confirmed by repeated experiments, that strong perspiration, often continued, for several days, is the consequence of this treatment. The matter perspired is in general exceedingly clammy, and has a nauseous foetid smell. In consequence of this perspiration the morbid affections gradually disappear, the patient feels himself lighter, and might imagine himself quite well, were he not obliged to drag about a heavy load of filthy matted hair, filled with a multitude of small worms \*. By cutting off the hair, the patient would be exposed to the utmost danger: the consequences are, blindness, incurable convulsions, and often death. There is an instance of a lady, who, after having been almost cured, died suddenly on attempting to draw a comb, even with the utmost gentleness, through her hair. The best method is, to bear the inconvenience with patience for three or four years. At the favourable period when the hair begins to be disengaged, at which time the young hair is seen springing up, the following rules are to be observed:—A place is to be sought for in the head where the matted hair is loose and raised up: into this place the finger must be thrust, and the operator must endeavour, but without using force, to loosen it every where around; and this process must be daily repeated, sometimes in one place and sometimes in another. The hair which has been completely disengaged is then to be cut with great caution. After this operation, should the pain in the orbit of the eye return, and if giddiness, accompanied with convulsive movements in the arms, should take place, the operation of disengaging the hair must be suspended, and bathing be resumed. By these means the affections not only disappear, but the remaining clotted hair often becomes loosened of itself. In this disease

\* The use of hair-powder, it is said, was first introduced for the purpose of concealing the deformity occasioned by this disease. EDIT.

the hair often swells in such a manner that blood issues from it when cut."

Dr. Brera is of opinion, that this terrible disease is not to be ascribed, as some believe, to the dirtiness of the people in Poland.

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*IX. On the Ammoniure of Cobalt, and an Acid contained in the Grey Oxyd of that Metal known under the Name of Zaffar. By L. BRUGNATELLI\*.*

THE metallic ammoniures have for some time past engaged my attention. These compounds result from a chemical combination of ammonia with metals. Hitherto they have been little examined, that of copper excepted, notwithstanding their characteristic properties, which distinguish them from other bodies. The ammoniure, which first became the object of my researches, was that of cobalt †. The particularities which it presented are as follows:—

1. I had several times observed that the precipitate, formed by ammonia in a solution of the nitrat of cobalt, was re-dissolved in that alkali. I collected some of it on a filter, and washed and dried it. On half an ounce of this precipitate, which was of a dark colour, I poured two ounces of liquid ammonia, stopped the bottle, and left it at rest. The temperature of the atmosphere was 20° above zero of Reaumur. At the end of twenty-four hours the alkali had assumed a dark-red colour ‡, and the precipitate was entirely dissolved. I thought I had formed a pure ammoniure, but I endeavoured to procure a larger quantity by other means.

2. I tried to dissolve small or blue cobalt in caustic ammonia, but without success, even when long digestion was

\* From the *Annales de Chimie*, No. 98.

† I have since examined the ammoniures of mercury, zinc, copper, and arsenic.

‡ Bergman had observed only that ammonia assumed a red colour with cobalt. *Cobaltum*, says he, *a niccolo differt quod omnibus acidis et alkali volunti solvatur colore rubro*. This circumstance has been noticed by all chemists without adding any thing to it.

employed; but I easily succeeded in dissolving the grey oxyd of this metal, commonly called *zaffar*. This substance afforded me the means of easily procuring ammoniure in abundance, and permitted me to repeat and vary my experiments different ways.

3. I evaporated to dryness the ammoniure obtained from *zaffar*. The concrete residuum I obtained, was composed of two very distinct substances; one of which had a dark red, and the other a pale-yellowish colour.

4. I poured distilled water on this residuum, stirring the matter with a glass spatula. The red part was entirely dissolved, and communicated to the water a beautiful rose colour. The yellowish matter remained undissolved.

5. The yellowish substance may be obtained during the evaporation of the liquid ammoniure, from which it begins to be separated at the moment when it is reduced to half its bulk. The red substance remains dissolved in the last quarter of the liquid \*.

6. The ammonia then takes from the *zaffar*, and holds in solution, two very distinct matters; one of which, soluble in water, has a red colour; and the other, insoluble in the same liquid, has a yellowish colour. The latter substance is the pure oxyd of cobalt. I think I discovered in the former a peculiar acid, distinct from all the other acids known.

#### *Of the pure Oxyd of Cobalt.*

7. The yellowish substance, which is separated by the slow evaporation of the ammoniure in the air or in the sun, may be considered as the pure oxyd of cobalt. It is insipid, inodorous, insoluble in water, and soluble in all the mineral acids. The nitro-muriatic acid forms with it a yellowish solution, which is in great measure deprived of its colour by the addition of a little distilled water.

8. This solution may be employed for sympathetic ink, like the common nitro-muriat of cobalt. Sometimes the acid refuses to dissolve the whole of the oxyd, but by adding a little water the solution is completed.

\* By preserving ammoniure of cobalt for some time, even in bottles well stopped, there is separated from it a yellow matter.

9. This solution is precipitated by the prussiat of pot-ash of a blueish-green colour, which does not change. It is not precipitated by the gallic acid, but the mixture acquires a darker colour. In other respects this solution exhibits all the phenomena of a common solution of cobalt in the same acid.

10. The muriatic acid dissolves exceedingly well the yellow oxyd, and assumes a beautiful highly-charged green colour. This colour immediately disappears with the nitric acid as well as with a little water, but it reappears by the addition of a little of the muriatic acid well concentrated.

#### *Of the pure Ammoniure of Cobalt.*

11. The yellow oxyd dissolves entirely in ammonia, and forms pure ammoniure of cobalt. This ammoniure has a yellow, and sometimes a rose, colour. It is not decomposed by acids. It is deprived of its colour by the muriatic acid. The prussiat of pot-ash changes it to grey, and occasions afterwards a deposit of the same colour. The sulphure of pot-ash makes it assume a dark colour inclining to black, and precipitates from it sulphure of cobalt \*. The borat (alkaline) of soda is decomposed by it, and precipitated into borat of cobalt of a very white colour.

#### *On the Acid drawn from the Ammoniure of Cobalt, and its Properties.*

12. The red substance of the preceding experiments was separated from the yellow oxyd. For this purpose I evaporated in the sun liquid ammoniure; and when it was reduced to about the fourth of its volume, and no longer precipitated in a sensible manner yellow oxyd, I filtered it through paper. What passed had a dark red colour, like decoction of cochineal. This liquor emitted no odour, but had a very pungent taste: it was again exposed to the sun till it was perfectly desiccated.

13. The remaining mass was dissolved in distilled water,

\* The sulphure of cobalt dried in the air approaches in colour to zaffar. When rubbed on paper it assumes a metallic splendour like the greater part of the other metallic sulphures: when heated it emits a sulphureous odour, and inflames when thrown on burning coals.

which

which was tinged of a beautiful ruby colour. This solution manifested an unequivocal character of acidity. On cooling, it deposited some small brilliant crystals, which I found to be a combination of the acid with ammonia. As this acid seemed to be distinct from all the other acids, I have given it the peculiar name of the *cobaltic acid*.

14. To ascertain whether the cobaltic acid could be separated from the ammoniure of cobalt by means of heat, I subjected a pound of it to distillation in a retort. After three-fourths of the liquid had passed into the receiver I stopped the distillation, and found that the retort contained a liquid rendered turbid by the yellow oxyd precipitated. I decanted the liquid after the precipitate had deposited itself, and evaporated it to dryness. The residuum was yellowish, and partly soluble in water, to which it communicated a yellow tint. This solution possessed all the acid characters of the red liquid of No. 15.

15. In another experiment I put a pound of the ammoniure of cobalt into a retort, and carried the distillation to dryness. The cooled matter which remained at the bottom of the retort was blue; but it had this colour only at its surface, being internally yellow. After some hours this blue colour disappeared, and the mass assumed a red colour.

16. A remarkable difference between the residuum of the evaporation in the sun and that by fire is, that the latter gave up to the water the cobaltic acid almost colourless, so that the solution, filtered cold, was almost as limpid as water. I remarked besides, that by the latter process the acid does not contain any, or contains very little, of cobalt of ammonia (*cobalt d'ammoniaque*).

I shall now enumerate the principal characters by which the new acid is distinguished.

1. It presents itself under a concrete form, and is not volatilised by fire.
2. It is sometimes of a red colour, sometimes pale yellow, and at other times entirely colourless.
3. It has no smell.
4. It has an acid, pungent, but not disagreeable taste.
5. It gives a tinge of bright red to an infusion of turnsol.
6. It

6. It is perfectly soluble in water.
7. It decomposes all the alkaline sulphures from which it precipitates the sulphur.
8. It precipitates ammoniure of copper of a bright green, and that of zinc of a pure white colour.
9. It precipitates the sulphat of copper of the same colour as the ammoniure of that metal.
10. It precipitates the nitrat of silver white;
11. The nitro-muriat of tin the same;
12. The nitrat of mercury of a clear straw colour;
13. The acetite of lead white.
14. It does not make any sensible change in solutions of gold and platina.
15. It precipitates lime-water in a white coagulum insoluble in water, and super-saturated with acid.
16. It precipitates the acetite and muriat of barytes.
17. It is separated from the water which holds it in solution by alcohol.
18. Employed as a sympathetic ink, it is not coloured green or blue like solutions of cobalt, but renders the paper brown and then black when it has been exposed to a strong heat, as is the case with other acids.
19. With tincture of gall-nuts newly made, it forms an abundant yellowish precipitate.
20. With a saturated solution of soda it gives an irregular transparent salt soluble in water, but not deliquescent in the air.
21. With pot-ash it forms a salt crystallisable in square crystals, transparent, and not deliquescent in the open air;
22. With ammonia a salt soluble in its acid;
23. With barytes an opake salt crystallisable with difficulty.

The presence of an acid in zaffar made me suspect that this acid might be of an arsenical nature; but this doubt soon vanished by comparing the characters of the two acids.

1st, The arsenic acid does not precipitate solutions of silver like the cobaltic acid. 2d, The arsenic acid precipitates lime-water: this arseniate is redissolved by the acid as well as by a fresh quantity of lime-water. The contrary is the

case with the acid of cobalt. 3d, The arsenic does not, like the cobaltic acid, decompose the muriat and the acetite of barytes. 4th, The arsenic acid is soluble in alcohol, which precipitates the cobaltic acid under a concrete form.

It remained to be ascertained whether the acid extracted from zaffar existed already formed in that oxyd, or whether it was produced by the action of the ammonia.

As the acid of cobalt readily dissolves in water, I boiled six pounds of zaffar in eight pounds of water for a quarter of an hour, and filtered the liquor while warm. What passed was transparent and colourless, but manifested a sensible taste. I evaporated the liquid, taking care to cover the vessel with a piece of silk. When reduced to one-half it became turbid, without the substance which was separated appearing sensibly coloured. I continued the evaporation till a third only of the liquor remained. When I removed it from the fire there was deposited a very white matter, which, on coming into contact with the air, assumed a beautiful rose colour. I separated this matter, and collected it on the filter.

The liquor which passed had a bright-yellow colour, and was perfectly transparent. It manifested in a decided manner an acid taste; reddened tincture of turnsol; speedily decomposed lime-water, salts of barytes, and those of silver; was precipitated with alcohol, &c. In a word, it exhibited all the properties of the cobaltic acid obtained by the processes before mentioned.

The red deposit which remained on the filter was insipid, and gave to the muriatic acid a very beautiful green colour. It was the pure oxyd of cobalt. This oxyd dissolved in a large quantity in its acid, and was precipitated from it in proportion as the latter was concentrated. The acid which the ammonia had separated from the zaffar was found then entirely formed in that substance. It still remains to be determined, in a positive manner, what is its radical. In the mean time I thought it my duty to retain its name of the *cobaltic acid*.

X. *Observations respecting Oysters, and the Places where found.*: By Professor BECKMANN.

[Concluded from Page 103.]

**I**RELAND has very abundant oyster-banks near the village of Arklow, on the eastern side of Dublin, from which feed is conveyed to the artificial beds of the capital on the northern side near Clontarf; and further south, at Sutton, not far from Howth. Also at Polebeg and Dalkey, not far from Dublin; and particularly Ireland's Eye, where the largest and best oysters lie at the depth of about eighteen or twenty fathoms under the water. Likewise to the north of Dublin, near Rush and Skerries, where the oysters are salter and harder than in places where more fresh water falls into the sea\*. Scotland has great abundance of oysters near the island of Inch Keith, which is not far from Leith.

I have no intention of enumerating all the places where oyster-beds are found; but I shall here give a list of those with which I am acquainted, because it perhaps may be of use to travellers who think objects of this kind not unworthy of their notice. These shell-fish are found in various places on the coast of France; such as the mouth of the Seine, where, though few in number, they are of an excellent quality. On the coast of Caen, in Normandy, there is a bank six miles in length and one in breadth. They are found also in the Bay of Isigny, and in the neighbourhood of Cherbourg. Those in particular are highly valued which are collected at the mouths of some streams where the sea-water is sometimes thrown entirely back, and which are called *buitres de pied*. Granville, in Normandy, gains 50,000 livres † by this fishery. On the coast of Brittany there are very large oysters, particularly at Concale, where a great many are preserved in places enclosed for the purpose. The bank at Painpol is almost entirely exhausted. At the mouth of the Loire; between the rocks on the coast of Poitou, on the coast of Aunis and Saintonge, where those who make bay-salt transplant oysters to

\* Natural History of the County of Dublin, by Rutty, Vol. I. p. 376.

† This at least is asserted in *Voyage dans les départements de la France*.

marshy places, in which they acquire a better quality, though they never become so good as the green ones of Saintonge; also à la tête de Buch, near Bourdeaux. In Languedoc, near Cape Leucate, there is an oyster-bank at the depth of twenty feet. At the mouth of the Rhone, on the coast of Provence. At Paris those oysters are most esteemed which come from Bretagne, Rochelle, Bourdeaux, and particularly from Medoc.

The Dutch have some oyster-beds on the coast of Zealand, near Zierikzee; oysters are kept there also in pits as well as at the town of Brouwershaven, and particularly at Petten in North Holland: those of the last-mentioned place are much esteemed, and are known under the name of Petten oysters. For these pits \* many ship loads are transported every year from the coasts of England.

There are exceedingly rich oyster-banks in the duchy of Holstein and in the neighbourhood of Jutland, which supply most of the oysters used in the northern part of Germany. I entertained hopes that we should have obtained a complete description of these oyster-beds in the highly valuable collection of the *Provinzial-blättern* of Schleswig-Holstein, as well as of the trade to which they give rise; but hitherto this hope, as far as I know, has never been realised. It gives me greater pleasure, therefore, to be able to supply in some measure this deficiency by the information on that subject, which, by the means of Professor Tychsen and M. Adler, I obtained from M. Todsen, a clergyman at Überg near Tondern.

The royal oyster-beds lie all together on the western coast of the duchy of Schleswig, between the islands Fanöe, Rom or Romöe, Sylt, Föhr, Amröm, Nordstrand, Silworm, Süderög, and extend from the district of Ripen to Helgoland. The number of the beds from which oysters can be fished is at present reckoned to be fifty: the greater part of them take

\* *Oesterpulten waarin de oesters gespeend worden.* Oyster-banks first arose on the coasts of Holland about the beginning of this century, a few years before it began to be observed that ships were destroyed by sea-worms, as we are informed by Sellius in his *Hist. nat. teredinum*, p. 289. See also Leeuwenhoek's *Arcana naturæ*, or *Experimenta et contemplata*.

their names from the persons by whom they were discovered. Some of them are a furlong, some a quarter of a mile, and some half a mile in length; and their breadth is equally various. M. Todsen ascribes, and with great propriety, the excellent quality of these oysters to the water which in the spring is swept by a continued east wind that blows from the continent through the canal and sluices. The oysters of these different banks are not all of the same kind; in some they are large, in others of a moderate size, and in many only small: the last, were they left to grow older, would never attain to a larger size. The large oysters are called *deputat-auftern*, the rest *kaufmansauftern*. Till the year 1794, the royal chamber of domains let these oyster-banks to the highest bidder for the term of six years; but as this period was too short for the persons who took the lease, and prejudicial to the fishery, they were let to the present lessee, M. Asmussen, merchant in Tondern, during his natural life, from the year 1795, for the yearly sum of 7505 dollars, which must always be paid in advance. He has bound himself to furnish yearly  $112\frac{1}{2}$  barrels of oysters to be delivered from time to time, but each time never less than four, and never more than eight barrels, carriage free, at Haderleben, for the royal family. This city is distant about ten miles from the village of Hoyer, where the oysters are landed, and which is a mile from Tondern. The lessee is permitted to fish for and sell oysters only during the four last and the four first months of the year. The instruments used for fishing up these oysters are of the same kind as those employed in other countries. The most common is a kind of drag-net made of thongs of seals-skin worked together, and fastened to an iron frame which scrapes up the oysters. These nets, when the fishermen have arrived at the proper place, are let down by means of ropes made fast to the iron frame. M. Asmussen uses at present eighteen vessels, which are perfectly similar to those of which figures have been given by Duhamel. The fishermen bring their lading either to the above-mentioned village of Hoyer or to Husum\*, which is seven

\* I have been told by a friend that prayers for the preservation of this  
H h 2 oyster-

seven miles from Tondern. From there the oysters are conveyed to Apenrade and Flensburg, and thence in ships to the East Sea, where the consumption is greatest, for a barrel sometimes is sold there at the rate of 100 roubles. It is not true that they cost dearer to the natives than to foreigners: a hundred cost a dollar; and a barrel, containing from 800 to 1000 oysters, about ten dollars, sometimes more or less.

The number caught, and the consumption, vary exceedingly in different years. During stormy weather and severe frost, none can be fished. The number fished up yearly, the lessee, for reasons which cannot be disapproved, has hitherto kept a secret; but it is certain that 2000 barrels would scarcely be sufficient to pay the rent and expences.

These shell-fish are more or less injured by frost and stormy weather, according to the depth at which they lie. Some beds at high tides have only eight, some three, and some scarcely two fathoms water above them; and the last suffer most when continued frost prevails with a wind from the east or north, because on those occasions the tide is scarcely perceptible on this coast. The beds during stormy weather are sometimes covered with sand and sea-weeds, but by the same cause they may be freed from them. Those beds which are in danger of being covered with mud, sand, shells, or seaweed, the fishermen endeavour to keep clean by continual fishing on them; but those beds which contain a great number of young oysters they spare as much as possible.

The five-fingered fish infests these beds, but the oyster-fishers call it the star-fish. A long red worm, also, with a great number of feet, is found among those oysters which are old and sickly. Oysters of three years old are accounted fit for sale. The lessee is forbidden, under the severest penalties, to fish up any younger. The fishermen must carefully separate the young ones from those which are eatable, and throw them back into the beds. To be able to distinguish the three years old oysters, it is necessary to be well acquainted with the oyster-bed were formerly offered up in the church of Husum; but this has been omitted for several years past, because the owner refused to allow the clergyman about two hundred oysters, which he claimed for performing that duty.

beds

beds where they are found : if this is the case, they may be easily known from the young oysters by their form, and the size of their shell.

The oyster-banks of Jutland lie on the eastern side of the northern extremity, near Fladstrand, a market-town, where there is a passage over to Norway; also at the island of Lessoe, situated in the Cattegat, three miles from Säbie, in the district of Aalborg. Respecting this fishery, several regulations have been published, one of which is dated February 1709. Attempts have often been made to transplant oysters to the large bays which extend from the Cattegat twenty miles across the country, and nearly intersect it; but they have been attended with as little success as those on the coast of Seeland.

Norway has excellent oysters, and in great abundance on the western coasts. The best are those found on the rocks, and called rock-oysters. Many of them are pickled, and sent in jars and other vessels, which contain the sixteenth part of a barrel, to different parts of the East Sea. These oysters often contain pearls; but they are not of a large size, and never have complete splendour.

Sweden has excellent oysters on the coast of Bahus-Län, near the island of Kasterö, a mile west from Strömstad, from which they are sent, as well as from Udewalla, to every part of the kingdom. The fishermen there pretend that, when an oyster-bed has been exhausted, it requires from four to five years before it is again stocked \*.

Italy has oysters of different qualities. Those found near Ancona are of a large size, but not very well tasted. Those are accounted the best which are produced in prodigious multitudes near Tarento, in the sea called *Mare Piccolo*, or *Il Picciol Mare*, which is a large bay that extends past Tarento towards the north-east. I mention this circumstance, because in most of the geographical books and charts these names are wanting. I found them only in an old chart of the *Terra di Otranto*, by J. Janson, though they often occur in books of travels.

\* Kalm's *Wästgotha och Bahuslanska resa*. Stockholm 1746. 8vo.  
p. 119 and 257.

The Mediterranean sea, in general, has more shell-fish than the ocean any where contains in the same space; but no part of it is more abundant in this respect than the *Golfo Tarantino*, the harbour of the city, and the *Picciol Mare*. Fishing is the principal or only occupation of the inhabitants, who chiefly live by it: on this account the greatest care is taken to preserve and increase the oyster-beds. At present there are seven, which belong partly to the king, partly to the clergy, and partly to private persons. They are all let on lease. Those who pay to the proprietors 30 carlini may fish for oysters till St. Andrew's day. It is asserted that they bring in yearly 21,348 ducats, and that the duty on all the oysters and shell-fish which are sent from the city amounts to 5615. If we add to this what is gained by the preparation of *byssus* (*lana pinna*\*) we may estimate, according to the assertion of the archbishop Joseph Capece-Latro †, the whole annual return at 100,000 ducats. Great care is here taken that the oysters may not be disturbed during the time they are spawning, and that all the young ones be thrown back again into the sea. It is generally believed here that all shell-fish are fattest and fullest at the time of the full moon.

The oysters of the *Mare Piccolo* are at present to the rich Italians what those of the Lucrine lake were to the ancients ‡. This lake extended in Campania from Baiae to the lake Avernus, and was separated from the sea only by a mole; but,

\* A kind of silky threads, about five or six inches in length, which some kinds of shell-fish (*mytilus pinna*) throw out, and with which they attach themselves to the rocks and other solid bodies. When these threads are burnt, they emit, as silk does, a smell like that of urine. The *pinna murina* throws out a *byssus*, which is fit for being manufactured, and is valued more than wool. At Naples, Messina, Palermo, and Corsica, stockings, gloves, &c. are made of this substance. They are exceedingly warm, and are considered as preservatives against the gout. EDIT.

† *Memoria sui istituzioni di Taranto*, without date or place: the author's name is found only at the end of the preface. See also Von Salis *Reisen in verschiedene provinzen des Königreichs Neapel*, in the appendix to the first volume.

‡ The oysters of Tarentum also were much esteemed by the ancients. Aulus Gellius, Lib. VII. cap. 16. or rather Varro, reckons the *escrea Tarrentina* among the greatest delicacies.

though it has been celebrated by so many poets, it is at present only a pond, which is scarcely sufficient for watering cattle. In the year 1538, on St. Michael's day, an earthquake, which had continued some time, became so violent that the lake retired from its banks, and its basin was almost entirely filled up; as was the case, in part, with the lake Avernus. The neighbouring small town of Tripbergala was swallowed up with all its inhabitants and riches. It contained a great many monks and nuns, who, it is said, led very irregular lives. "It might have been expected," says Blainville, "that the gulph would have been satisfied with the nuns and monks, and that it would not have carried its revenge further: but this was not the case; as a monument to posterity, it threw up such a quantity of filth, that it produced a mountain a mile in height and four miles in circumference."

The Venetian oysters I have already mentioned. They are sent to Vienna, and perhaps further; and those who are accustomed to old oysters are said (no doubt ironically) to find them much more pleasant than fresh ones when they meet with them in other places\*.

For some years past oysters have been brought to Hamburg from the following places, though from many of them their arrival is accidental:—London; Havre; Schelling, an island near the coast of West Friesland; Borkum, an island near Groningen; Soltkamp, in the province of Groningen; Wangeroeg; Feversham; Amerum or Amrœn, an island near Rypen; Schirmerkog, and Feburson. With the last place, to which ships, I believe, have gone only within these two years, I am not acquainted. The one before, no doubt, means the island of Schiermonikkoog, which lies near Friesland, to the east of the island of Ameland. Wangeroeg is

\* Becher, in his *Narrijcb Weisheit*, p. 201, justly ridicules the proposal of William Schröder, son of the then chancellor of Gotla, for stocking the ponds in the gardens of Vienna with oyster-breed: for oysters require salt water; and even new beds formed in the sea do not always succeed. The Society for the Encouragement of the Arts at London has often offered premiums on this subject. See *Memoirs of Agriculture*, by Dossie. London 1763, Vol. I. p. 307.

an island which belongs to the lordship of Jever, and lies at the distance of a mile from Wangerland. J. J. Winckelmann says, in his Oldenburg chronicle: "In the E. S. E. near this island, oysters were transplanted about twenty years ago, and propagated, but they have been reserved for the sovereign lord." Winckelmann wrote about the end of the last century, but in what year I have not been able to learn.

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## XI. *Description of Mr. COLLIER's improved Apparatus for Filtering and Sweetening Water and other Fluids.*

**T**HE importance of obtaining pure water for culinary purposes is so obvious, that any invention for facilitating that object deserves, and will be sure to meet with, due attention from the public, as it is a matter that very much concerns their health.

The general practice of passing a fluid simply through the pores or interstices of any compact substance is attended with obvious objections. If the filter is either of animal or vegetable production, it must necessarily be acted upon by the fluid, which at the same time percolates through its own sediment and corruption. Hence arises the necessity of frequent change of the filter, which, while it does not altogether remove the evil, is at the same time attended with much trouble and expence. If we use natural or artificial stone, or any other substance found in the mineral kingdom, the sediment finds its way into the substance of the filter, which is thereby rendered extremely foul, and cannot be completely cleansed by any contrivance hitherto resorted to for that purpose. In percolations through sand, or any thing in the form of powder, this reasoning does not completely apply; but in that case the powder must be often displaced to be washed or changed. If unconfined, the fluid forms channels for itself in various directions; and if confined, as by mechanical force, in a strong box, it is liable to the very objections urged against the use of compact substances. The inventor of the machines, of which it is now proposed to give some account, does not pretend to have arrived at the *ne plus ultra*

*ultra* of improvement in an art of so much importance to society as that of purifying water. So far, however, as concerns the difficulty hitherto complained of in the process of filtration, we think he has completely succeeded. He has also consulted the only true principles which can shorten the extreme tediousness of this process.

First, The grosser particles and corruption form no obstruction, as the fluid takes a direction from the exterior of the filter inwards.

Secondly, As the filtering medium comprises numerous cylinders of small diameters, the contents of which are also small compared with their external surface, the percolating superficies altogether is as much increased as the magnitude of the machine will allow.

Thirdly, As these cylinders do not themselves form the vessel containing the fluid, but are placed in the vessel, they sustain a pressure proportioned to the whole perpendicular height of the fluid within it.

Moreover, it must be admitted that the substance chosen as a percolating medium is free from any possible chemical objection, being formed of materials of sufficient durability, and altogether insoluble in water and most other fluids.

Fig. 1. (Plate IX.) a section of a cistern of any materials and of any size, with a cock A to draw water for common use. B, a leaden reservoir, holding 4, 6, or 8 gallons, placed inside, the cock C of which comes through and is soldered into the side of the cistern, from which filtered water is drawn off. The bottom of the reservoir is raised about two inches above the lower edge DD of the side B, that it may stand above the sediment in the water.—EE are 4, 6, or more hollow cylinders, closed at one end, fastened into the lead, formed of argil and filex baked together in a potter's kiln, through which the water percolates into the reservoir B.—F, a tube a few inches diameter, as high as the cistern, with a small aperture at top for the air to escape, while its dimensions answer another purpose. As water will find its level when the machine has been long at rest, the water will obtain the same altitude in the tube as it stands at in the cistern; and whenever it is drawn off for common purposes, the same principle causes it to fall in the tube, passing inversely through

the pores of the cylinders, and producing thereby a reflux as well as a flux, which will always keep the pores free from any obstruction.

Fig. 2. a section of a cask or tub, contrived, as to the filtering part, precisely on the same principles, but furnished with a sweetening apparatus, which consists of broken crockery placed between two partitions, so that the water poured in at the top falls through small apertures upon innumerable surfaces; and the cask being perforated all round at GG, is exposed to atmospheric air, probably some hours before it escapes drop by drop into the division below.

The reservoir only differs in shape from those contrived for cisterns, as may be seen Fig. 3. which is a horizontal section of the cask Fig. 2.

Fig. 4. a section of a case lined with lead, and furnished inside with cylinders supported on a frame above a cistern lined with lead to receive the filtered water. It only differs from the cask in this respect, that the filtering process precedes the sweetening; the foul water is drawn off at the upper, and the water for use at the lower, cock. A funnel or basin, with a hole in its bottom, is placed within the frame of this apparatus between the case and the cistern already described. Through this funnel, which is filled with broken crockery, the water which falls from the case is obliged to pass before it can reach the cistern. A vertical section of this funnel is represented in Fig. 5.

This apparatus is provided with handles and rings designed for the convenience of moving, lashing to a ship, &c. The frame is furnished with a hanging door on each side impanelled with canvas, which, while it excludes dust, admits air, and may be lifted up to examine the state of the cistern when necessary.

Fig. 6. a longitudinal section of one of the cylinders, and a separate view of its bottom, into the square hole of which a tube of box wood enters. The cylinder is fixed by means of a nut and screw, and, with the assistance of leather, a sound joint is made to connect it with the leaden bottom of the case Fig. 4 and 5.

It would be vain to attempt, by mere mechanical means, to free water from those principles which are held in a state

of perfect solution ; nevertheless it is of great importance, by rendering rain or river water as clear and transparent as hard water (spring water), to preclude in most cases the necessity of using the latter, which generally abounds with pernicious impregnations collected from the bowels of the earth by chemical decomposition.

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## XII. *A cursory View of some of the late Discoveries in Science.*

[Continued from Page 132.]

**B**ARRUEL has made researches respecting the cause of elasticity, which he ascribes to two principles: 1. "Every body in nature," says he, "is porous, and these pores are proportioned to the density of the substance: 2. These pores are filled with different fluids, and principally with caloric. But caloric possesses a strong repulsive force; from which it follows, that, when an elastic body is compressed, the caloric in its pores drives back by its repulsive power the displaced parts, and brings them to their former state." Libes, who has examined the same subject, makes elasticity to depend on caloric interposed either between the moleculæ of the bodies, or combined with them, and at the same time on the attractive force of these moleculæ. "This being premised," says he, "I say, that the restoration of solid bodies after compression is a combined effect, which depends in part on the repulsive force which their integral moleculæ have received from caloric, and in part from the attractive force of these moleculæ." He then applies elegant formulæ of calculation to these phenomena.

Soquet has made experiments, which seem contrary to those of Count Rumford, respecting the non-conductibility of caloric by fluids. "I have seen," says he, "at Venice a piece of glass, in a state of incandescence, immersed into a pail of water without the latter being reduced to a state of vapour; but, having plunged my naked arm into the water, I found it exceedingly hot. I then approached my hand gently below the mass of glass, and sensibly felt its heat." He admits, however, that fluids in general are not good conductors of

caloric. He then makes some researches respecting the cause why the water is not reduced to vapour by incandescent glass, while it is by incandescent iron.

Piötet has given some very interesting observations on elastic fluids, and aqueous vapour in particular. It appears that all fluids are indebted for their elastic state to the matter of fire, or caloric. Some preserve this elastic state at every temperature, and this is the case with aqueous vapour. The author endeavoured to determine the quantity of caloric contained in water in a state of vapour at the temperature of ebullition; and experience proved that this aqueous vapour had eight or nine times more caloric than the same water in a liquid state at the same temperature. The following are the means he employed to obtain this result:

Let  $M$  be one of the masses, and  $T$  its temperature;  $m$  the other mass, and  $t$  its temperature; the temperature of the mixture will be  $\frac{MT + mt}{M + m}$ .

This formula he applied to the following experiment:— He took a balloon, the water in which weighed six ounces, and was at the temperature of  $13^{\circ}$ . He introduced into this water, for five minutes, the vapour of an eolipyle, and the temperature of the water rose to  $49^{\circ}$ , that is to say, was raised  $36^{\circ}$ , and its weight was increased 228 grains. He then endeavoured to discover what calorific effect would be produced by 228 grains of boiling water on six ounces or 3456 grains of water at the temperature of  $13^{\circ}$ ; that is to say, what would be the temperature of the mixture.

By applying the above formula he had  $\frac{3456 \times 13 + 228 \times 80}{3456 + 228}$

$= 17^{\circ} 15'$  for the temperature of the mixture. Boiling water then did not produce but  $4^{\circ} \frac{1}{2}^{\circ}$  more heat in six ounces of water at the temperature of  $13^{\circ}$ ; while the same quantity of water, in a state of vapour, at the temperature of  $80^{\circ}$ , raised the heat  $36^{\circ}$ . The calorific effect, therefore, of water in vapour is about  $8\frac{1}{2}$  times greater than that of the same water, boiling. But the volume of the vapour is about 1800 times greater than that of boiling water. There is therefore 212 times more fire in any given volume of boiling water than in

in an equal volume of vapour. The author then makes various applications of these principles, but particularly to steam-engines, the different degrees of the power of which he determines according to the state of compression of the aqueous vapour.

Perolle has made experiments on the intensity of sound in different gases, which seem to give a result contrary to those of Priesley, Chladni, and Jacquin jun. Maunoir and Paul, of Geneva, having inspired hydrogen gas without being incommoded by it, were much surprised, when they attempted to speak, to find that their voice had become shrill and squeaking.

Perolle has given experiments also respecting the propagation of sound, by which he shows that air is not the best medium for conveying it. He stopped his ears with bits of chewed paper, and, having applied his watch to them, could not hear the noise of its beating. He removed the watch, and placed it in contact with a small cylindric piece of wood, the other extremity of which touched one of those external parts of the head that propagate sound; such, for example, as the cartilaginous parts of the ear; and he then heard the beating of the watch.

He suspended the watch in the middle of a bocal, and found that the sound reached him; but having filled the bocal with water, the sound was much stronger. The joints of the watch had been luted. He placed the watch on different bodies, such as wood, a marble table, &c. and found that the latter transmitted the sound faintly, while the former transmitted it with greater or less force. He thence concludes that the sound of musical instruments, such as violins, harps, harpsichords, &c. depends on the property which wood has of transmitting sounds; and that houses built of marble or stone are less sonorous, because these bodies are worse conductors of sound.

Lamarck has observed that sounds are transmitted in vacuo in water, and through the most solid bodies. The cannon of Toulon are heard at Monaco, that is to say, at the distance of more than 25 leagues, while one is lying on the ground; but the same sounds are not propagated nearly so far in the air. From this he concludes:

1st, That

1st, That the common air in which we live is not the proper matter which conducts sound, since, notwithstanding the great transparency of this fluid, it is still too gross to penetrate freely the masses of those bodies which have greater density than itself; a property which the matter fit for conducting sound evidently possesses.

2d, That there exists an invisible, exceedingly subtle and singularly elastic fluid, of extreme rarity, which easily penetrates all bodies, which is diffused throughout every part of our globe, and consequently throughout our atmosphere.

3d, That this fluid is the essential cause of the elasticity with which atmospheric air seems to be endowed, and that it is to the vibrations communicated to this subtle fluid—vibrations which are transmitted with great celerity through different mediums, and even the most solid—that we ought to ascribe the immediate cause of sound and noise in regard to us.

4th, That the subtle fluid which constitutes the propagating matter of sound is exactly the same as the ethereal fire, of which the author says he has demonstrated the existence in his different writings, and which may be considered as the ethereal fluid mentioned by Newton, if to its well known properties we do not add the supposition by which Newton gives to its vibrations a velocity greater than that of light.

Tremery has confirmed the opinion of those who think that electricity is propagated in vacuo. He exhausted entirely of air the tube of a barometer; and having extracted a spark by means of a metallic rod, the electric fluid passed in the vacuum, and the whole inside of the tube became luminous.

#### ATMOSPHERIC AIR.

Humboldt has published the result of his observations on the nature of atmospheric air, by which it appears that the purity of this air is subject to great variations. The sum of his observations is as follows:—The quantity of oxygen contained in atmospheric air decreases according to the abundance of clouds, fogs, rain, and snow; but it increases during dry

dry and serene weather. After great rain the eudiometer indicates in atmospheric air only 0.264, and 0.259 of oxygen. But when the blue sky appears, the eudiometer marks 0.284 of oxygen, and as far as 0.290. The experiments of Read seem to announce a combination between oxygen and electricity; but we are still ignorant whether the air being charged with the electric matter has any influence on its purity. Buch collected the air of the Gisberg at an elevation of 3890 feet, and Humboldt found this air exceedingly impure. It appeared by the eudiometer that it contained 0.026 less of oxygen than that of the plain; which confirms what we before knew, that the air on high mountains is more impure than that found at a less elevation. The purity of the air varies to such a degree, that the author saw the eudiometer announce, between April and November 1797, from 0.290 of oxygen to 0.236. But, does atmospheric air contain only oxygen, azot, and carbonic acid? The author thinks it probable that it contains also a portion of hydrogen, which combines with the azot, and which we have no means of detecting. Humboldt collected air in the crater of the peak of Teneriffe, at the height of 1904 toises, and found in it only 0.19 of oxygen. It must be observed that there is no longer any eruption from this crater. The pure air of the plain at the bottom of the peak contains 0.278 of oxygen. The air at sea in the latitude of  $10^{\circ} 30'$  contained more than 0.30 of oxygen. This observation shows that the air at sea contains more oxygen than that at land\*.

#### METEOROLOGY.

Bouvard continues to make meteorological observations with great accuracy. He has found the variation of the needle at Paris to be  $22^{\circ} 15'$ , and the dip  $70^{\circ} 35'$ . Coulomb employs a new process to find the dip of the needle, which at Paris he estimates at  $68^{\circ} 10'$ .

Humboldt has made interesting observations respecting the magnetic needle. The following is the result of those in

\* For other important information connected with this branch, see Dr. Van Mons's letter in our last, and Dr. Girtanner's in our present, Number,

regard to its dip. The magnetic force is measured by the number of oscillations which the needle makes in a minute. The inclination is given in degrees of the circle divided into 400 parts.

Places.	Latitude.	Longitude.	Dip.	Magnet. force.
Paris - -	48° 5' 15"	0° 0' 0"	77° 15	24·5
Nimes -	43° 30' 12"	0° 7' 56" E	72° 65	24·0
Montpellier	43° 36' 29"	0° 6' 10" E	73° 20	24·5
Marseilles	43° 17' 29"	0° 12' 14" E	72° 40	24·0
Perpignan	42° 41' 53"	0° 2' 14" E	72° 55	24·8
Barcelona	41° 23' 8"	0° 0' 33" W	71° 80	24·5
Madrid -	40° 25' 18"	0° 24' 8" W	75° 20	24·0
Valencia -	39° 28' 55"	0° 10' 4" W	70° 70	23·5
Ferrol - -	- - -	- - -	76° 15	23·7
At Sea -	32° 16'	17° 7'	71° 50	24·0
Ditto - -	26° 51'	19° 3'	67° 20	23·0
Ditto - -	14° 15'	48° 3'	55° 80	23·9
Ditto - -	13° 51'	50° 2'	50° 15	23·4
Ditto - -	10° 59'	64° 31'	46° 50	23·7

He found the variation at Marseilles on the 11th of November  $22^{\circ} 55' 30''$ ; at Madrid, in May,  $22^{\circ} 2'$ ; and at Aranjues, about the same period,  $21^{\circ} 58'$ . The water of the sea appeared to him to be less dense under the equator than at some distance from it.

Buch has given some researches respecting the barometer, in which he examines the causes of its variations. In his opinion, the state of the barometer and its variations do not depend on the state of the surface of our globe, and we must seek for the causes beyond it. His proofs are:

1st, That the barometer varies very little under the tropics, and that its variations increase on approaching the poles. But if these variations depended on the state of the atmosphere, they ought to be equally perceptible over the whole surface of the globe.

2d, The barometer often remains almost motionless amidst the greatest agitations of the atmosphere. Thus, in 1794, when Vesuvius was in the utmost agitation, and when the air was filled with the flames, ashes, and smoke of the volcano, the barometer was almost motionless.

Cotte has presented a view of the severe winters which we have experienced. A dispute had arisen among the scientific men at Paris respecting the cold which would take place in the winter of the year 1798: and some asserted that it would be severe because that of 1398 was so; founding their opinion on this circumstance, that the same temperature must take place every four hundred years. Mazuyer maintained, that the severe winters in our climates take place between the fourth and fifth year, or the eighth and ninth years; because, according to the remark of Tealdo, the seasons and constitution of the years must have a period almost equal to the revolution of the lunar apogeeum, which is from eight to nine years, and that, towards the middle of this period, that is to say, every four or five years, there must be a return. Thus the severe winter of 1788-1789 followed one which took place ten years before; and that of 1794-1795 took place four years after that of 1788-1789.

Cotte seems rather to refer to the period of nineteen years, which brings back the moon to the same points. He estimates, therefore, that the general temperaturé of any year ought to correspond with that of each antecedent nineteenth year after the commencement of the century. But these rules he considers only as probabilities.

Lamarck has published an annuary, in which he endeavours to determine a prognostication of the temperature from the position of the moon in the southern or northern signs. When she is in the southern, it is probable that north and east winds will prevail; when she is in the northern, it is probable that south and east winds will be most prevalent; and these winds have a decided influence on the temperature and rain\*.

Cotte has given an extract of a memoir, by Beaumé, on thermometers. The motion of those made with spirit of wine is different from those made with mercury. Thus, near the degree of boiling water, when the mercurial thermometer falls five degrees, that made with spirit of wine falls seven; and on the other hand, near the freezing point, when the mercurial thermometer falls five degrees, that made with

\* See also Toaldo's paper on this subject, Phil. Mag. Vol. IV. p. 367.

spirit of wine falls no more than three or four. The mercury dilates from the freezing point to that of boiling water, in the ratio of 5045 to 5122, or of a 65th part of its volume. Mercury in a state of ebullition in the open air makes the mercurial thermometer rise to 190 degrees, the barometer being at 28 inches.

#### GALVANISM.

Jadelot has translated into French Humboldt's work on galvanism, to which he has added a great many of his own experiments. The general consequences he presents are as follows :

1st, The effects of galvanism are for the most part different in the different parts of animals.

2d, The diaphragm, in warm-blooded animals, is that muscle which, if not irritated most strongly, is at least irritated with the most readiness; for it is the only one that always contracts itself with the greatest violence in experiments where no chain is formed, but which do not however succeed unless in those whose irritability is greatly exalted. May not this observation contribute towards determining the respective degrees of the irritability of the different muscles? These experiments attest :

3d, That, as Humboldt has remarked, the living nerves and muscles are surrounded with an active and sensible atmosphere; a condition that, added to the conducting property in which the animal organs participate with all moist substances, supports the explanation of professor Reil respecting the action of the nerves, which extends beyond the points where they disperse themselves.

4th, That, as Humboldt observed also, galvanism may excite movements in the organs altogether independent on the will, as in the heart and stomach.

5th, That the galvanic fluid, coming from a warm-blooded animal, may act with efficacy on the nerves of the human body.

6th, That the galvanic phenomena take place without the intervention of any external body: that, thus, the cause which produces them resides in the living animal economy.

7th, That they can manifest themselves by means of a chain established between two points of the same nerve, and by adduction in organs brought into contact with some part of the flesh.

Vafiali-Eandi has given interesting observations on galvanism. "We do not yet know," says he, "what is the cause of these extraordinary phenomena: Volta is inclined to believe that the muscular contractions are excited by the electricity which the metals that touch each other, or the heterogeneous bodies that serve as conductors, acquire; and that, consequently, we see no animal electricity in the phenomena of galvanism; which, according to this theory, proves nothing else than that animals are electrometers more sensible of the smallest degree of electricity than other electrometers." The author then relates the experiments of those who ascribe all these phenomena to an electricity peculiar to animals; and he concludes by saying—"Were I to declare my opinion, I should be inclined to believe that the muscular contractions are produced by the movement of animal electricity directed by the conductors of natural electricity." The changes of electricity which different fluids experience in the body, may serve to explain these phenomena; for he himself has proved, for example, that urine when issuing has negative electricity, while the blood which flows from a vein has positive electricity.

Fabbroni has published an important work on several phenomena ascribed to galvanism. Instead of ascribing the effects to electric fire, he is of opinion that they depend on a chemical operation; that is to say, an action exercised by the two metals on each other. (See *Phil. Mag.*, Vol. V. p. 268.)

[To be continued.]

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### XIII. *On the various Remedies that have been recommended for the Cure of the Hydrophobia.*

**W**E shall not distress our readers by a painful detail of the symptoms and progress of this dreadful malady, but content ourselves with giving such remarks on the various methods of cure as may prove useful to mankind.

Sea-bathing was for a long time held to be a sovereign cure, if timously resorted to : the many melancholy failures, however, of this boasted remedy have long since convinced medical practitioners, that even in those cases where a supposed cure had been effected, there had actually been no disease ; the saliva in such cases having been previously cleansed from the tooth of the animal that inflicted the bite, by passing through thick clothes before it reached the patient's skin.

Mercurial frictions, there are reasons for believing, have sometimes proved beneficial in the hydrophobia. Dr. Fothergill seems inclined to ascribe their good effect more to the ingredients with which the mercury is made into an ointment, than to the mercury itself : But of this hereafter. Dr. Metée ascribes them to the volatile alkali which the mercury disengages from the ammoniacal salt contained in the lymph of the animals.

The king of Prussia, in the year 1777, purchased from a Silesian peasant a remedy for the hydrophobia, which he ordered to be kept prepared in all the apothecaries' shops, and by all surgeons. The basis of this remedy is the *meloë proscarabæus et majalis*, (oil-beetle \*,) a black unctuous insect, which, when touched, emits from all its articulations a brown oily liquor, and on that account it has been called the oil-beetle. It is found in almost every country in the spring. It is called sometimes the farrier's beetle, because the farriers prepare from it a blistering ointment by pounding three hundred of the insects in a pound of oil of laurel. The following is the method of preparing the anti-hydrophobic remedy of Prussia :

R. Take twenty-four beetles preserved in honey, two grains of ebony wood, one grain of Virginian snake-root, one grain of filings of lead, twenty grains of the moss of the ash-tree, four ounces of theriac, and a little of the honey in which the insects have been preserved.

The dose of this opiate varies according to the age and sex of the patients. It is to be taken once in a dose of two grains for male adults, a grain and a half for females, and a grain

\* See C. T. Schwartz de hydrophobia, ejusque Specifico Melœ majali et proscarabæo. Halæ 1783.

for children of twelve years of age, diminishing the dose according to the age. Four grains are given to oxen morning and evening, and they are made to fast twenty-four hours. It is recommended to those who take this remedy, to remain twelve hours in bed in order to excite perspiration. The patient also, during that period, must abstain from food and drink. It is recommended likewise, in the observations on the Prussian cure, to burn the shirt which the patient had on while subjected to perspiration. The wounds are to be washed with wine and vinegar into which salt has been put, and to be afterwards dressed with basilicon or salt butter. If this remedy succeeds, its effects are to be ascribed to the *proscarabaeus meloë*, which has the property of cantharides; an insect which belongs to the same genus, and which the celebrated Stoll, professor of medicine at Vienna, and director of one of the hospitals in that city, has asserted to be a specific in the hydrophobia. His first care was to cover the wound with a vesicatory, which he continually renewed. He prescribed internally tincture of cantharides, at first two drops, which he increased progressively for forty days, according to the age and constitution of the patient: the dose at last was carried to twenty-four drops, which may seem almost incredible. This medicine is the most violent diuretic known, and the application of it requires an able hand: but its efficacy is asserted to be well established; as also, that it produces the most salutary effects even when the hydrophobic poison has had time to diffuse itself throughout the mass of the blood. In the last stages of the disease, the obstacle hitherto most invincible is the difficulty of making the patient swallow any remedy. Every body knows the convulsions and horrid paroxysms into which the unfortunate sufferers are thrown merely by the sight of any liquid. Stoll was of opinion, that the effect of the hydrophobic virus on the senses is directly the reverse of that of opium: it augments irritability as much as opium lowers it: the least noise, the smallest degree of light, to persons labouring under this dreadful malady, produces torture beyond description; and the dissection of bodies, in which no change in the humours or in the organisation was observed, seems to prove that this opinion is well

well founded. If these obstacles, then, were removed, and if the patients could swallow the remedies prescribed for them, there is reason to think that their lives might be saved. Stoll entertained some good ideas on this subject; but want of opportunity, and premature death, prevented him from applying them to practice. He was of opinion, that the excessive irritability, occasioned by the hydrophobic virus, might be overcome by opium; and, as the patients cannot swallow any thing, he proposed administering it in injections. The difficulty here would be, to determine what quantity of opium ought to be employed; but, after proceeding far enough to produce the intended effect, the patient would then be able to swallow the tincture of cantharides; and, as there is no time to lose in such cases, it would be necessary to raise the dose at first to four drops, and to follow up the cure with activity.

If Stoll's idea be correct respecting the action of the hydrophobic virus, the high state of irritability might, we think, be subdued speedily by making the patient inhale *hydro-carbonat*. The idea is certainly worthy of the attention of the faculty; but this gas should not be resorted to except with the aid of a physician. With such aid, however, if a mere reduction of the irritability be all that is necessary to enable the patient to swallow medicines, the end might certainly be gained.

C. Delametherie \* informs us, that several eminent physicians, such as Tislot, Lassore, Blais, Belleteste, &c. have employed the volatile alkali with success in the hydrophobia. In the *Gazette de France* of May 4, 1799, there is an extract of a letter from Carmont in Andalusia, dated March 27, the same year, which says, that a shepherd having been bit by a mad dog, and symptoms of the hydrophobia having begun to appear, Don Candido Trigneros, a physician in the neighbourhood, applied to the wound a little lint dipped in volatile alkali, and with the approbation of Don Joseph Mexia, of the Medical and Patriotic Societies of Seville, ordered the patient to swallow, for four days, twelve drops of volatile alkali in three ounces of water; which made the symptoms of madness disappear.

\* *Journal de Physique, Ventose, an. 8.*

“ I re-

"I received," says Delametherie, "a letter dated August 7, 1778, from M. Noguerez, curé of Passy-lès-Paris, in which he gave me an account of the method by which he cured of the hydrophobia a gardener named Olivier, who had been bit in the middle finger by a mad cat. Some days before, a man in the same house, who was bit by the same cat, had several fits of the hydrophobia, of which he died in the Hôtel-Dieu. It was not till twenty days after the accident happened, that Olivier's sleep began to be interrupted by violent agitations, during which he was delirious. When awake, his eyes had a haggard appearance. The curé having administered to him fifteen drops of volatile alkali in a glass of water, his patient paid him a visit next morning, and informed him that he had enjoyed good rest during the whole night. The curé made him take, for two days longer, ten drops of alkali in a glass of water, and ever since Olivier has remained in good health. I have employed this remedy with success for preventing the hydrophobia."

C. Pelletan, one of the most celebrated surgeons of Paris, has inserted in the public papers, that, by cauterising the part bit, and afterwards plunging it into cold water, the effects of the hydrophobic virus might be prevented. "This fact," says Delametherie, "brings to my remembrance an experiment which a game-keeper of Ile Adam made, several times successively, in the presence of the late prince of Conti. He caused himself to be bit in the arm by a mad dog, sprinkled over the wound some gunpowder, and, having set fire to it, tied up his arm in a wet cloth. These bites were never attended with any bad consequences. I was a witness to an experiment of the like kind made at Blois by a limonadier, near the bridge. Having been bit in the hand by a mad dog, he immediately burnt some gunpowder on the wound, and continued well.—The theory of this important fact is as follows: The burning decomposes the animal tissue, and disengages volatile alkali, which is circulated with the blood, and neutralises the hydrophobic virus. Volatile alkali acts with the greatest efficacy, and prevents the effects of the hydrophobia. It is sufficient to put some of it on the wound, and

and to use it internally after it has been diluted with a considerable quantity of water."

The Ormskirk medicine, from its great celebrity, deserves some notice here; and the more so, as we can lay the recipe before the world, which will enable medical men justly to appreciate its pretensions. The quantities of the various ingredients are, to be sure, rather loosely expressed, were accuracy a matter of moment in such a compound: "Rx. A small tea-spoonful of prepared oyster-shell; one case-knife pointful of roach-alum, burnt; one case-knife pointful of Armenian bole; as much elecampane root as will lie on a silver sixpence, and the same quantity of ash-coloured ground liverwort—all in powder. They must be well mixed together. The dose for a person of the strongest constitution is two drachims, apothecary's weight, in a glass of red port, taken in the morning fasting. The patient must fast for two or three hours after."

The above was sent to the editor for the purpose of being laid before the public through another medium (a newspaper) so far back as the year 1791, but by some accident was mislaid till a few days ago\*. The author, after enumerating the virtues ascribed to the various ingredients by different writers, which we give in a note in his own words†, concludes with the following observations:

"What

\* It is dated "Bispham, Lancashire, 28th October 1791," and bears the Ormskirk post-mark.—No signature.

+ "If for a cow, horse, or pig, give double the quantity, in a pint of milk or water: if for a dog, give the double dose in a little new churned butter, without salt; and take care to tie him up, in a clean place, without litter, as they are subject to vomit it up again. The quantity of each ingredient above is rather uncertain, if the consequence signified any thing. The oyster-shells are to be well cleaned, pulverised, and levigated into an impalpable powder, which may be dried on a chalk-stone, and afterwards set by in a warm or very dry place for a few days. The Edinburgh College give the preference to those shells which are hollow. This has the virtues of other testaceous powders. The alum is to be burnt in an earthen vessel, or one of iron, as long as it bubbles or swells up. The bole is not always found pure; it should be of a bright-red colour, with a tinge of yellow. It will effervesce with acids; and in order to free it from impurities,

"What degree of confidence ought to be placed on the medicine, must be left to the judgment of the discerning; as also, whether a preference ought not to be given to that grand corrector and blunter of all animal poisons, OLIVE OIL; especially if camphor is dissolved in it? We have an account from the continent of its curing the hydrophobia in a very advanced state, when given in large doses; and we know that it certainly is an effectual cure for the bites of serpents, vipers, &c."

From what source the author of this letter learnt that the  
rities, powder it and wash it: the finer part may be decanted into another  
veessel; the impurities will remain. After the finer parts are subsided, pour  
off the water, and dry the bole for use. Bole was formerly much esteemed  
as an alexipharmac, and singularly serviceable in malignant and pestilential  
diseases.

"The inula, or elecampane, grows commonly in moist places, and is often cultivated in gardens; the flower is a yellowish-green, somewhat similar to a chrysanthemum, but larger. According to Linnæus, it is the second order of the 19th class, *Syngenesia Polygamia superflua*. The root is here to be used only. In the recent state it does not smell so strong as in the dry; for it then is highly aromatic. The proper time for taking up the root is toward the end of September. The druggists have a trick of mixing other substances with it when it is purchased from them in powder. As a medicine, it was formerly in high estimation. Rembertus Dodonæi, an eminent German botanist, who wrote about 220 years since, says it is an excellent remedy against the bite and stings of all venomous animals. Dr. Hill says, from his own experience, that an infusion of the fresh root, sweetened with honey, is an excellent remedy for the hooping-cough.

"We now come to the liverwort, which stands part of the original prescription, although often omitted. Dr. Mead judged it of that importance as to recommend it, with black pepper, under the title *Pulvis Antilyffus*, to the College of Physicians; and it found a place in the Dispensatory. *Canninus*, liverwort: the leaves are covered with a kind of ash-coloured mealiness, leather-like, flat with blunt lobes, targets on the edge ascending. Dillenius 200, tab 27, fig. 102, calls it *Lichenoides digitatum cinereum Lutucæ foliis sinuosis*. It grows common on old cops, heaths, woods, and hedges. Mr. Hudson calls this genus Liverwort: but, as the *Marchantia* of Linneus is commonly known by the name of Liverwort, it is necessary to mention this difference in order to avoid mistakes; for, when once a person is acquainted with this Cryptogamia plant, he will not easily forget it when he sees it again. Dr. Withering, of Birmingham, a sensible, well informed, and ingenious gentleman, gives this genus the English appellation of Cupthong."

hydrophobia had actually been cured by the use of olive oil, we know not; but the fact is worthy of the more notice, as the same remedy has lately been recommended by Dr. Fothergill, of Bath\*, without knowing the fact, but with a force of reasoning that cannot fail to insure its receiving proper attention. Speaking of oleaginous medicines, the Doctor says: "The ancient remedy against the bite of the viper was long confined to the fat of that reptile, till it was at length discovered that olive oil was equally efficacious; a circumstance since well known to viper-catchers, and confirmed by reiterated experiments. Whether it act by a specific power, or merely by inactivating the poison, or otherwise destroying its activity, matters not; the fact has always appeared to me interesting, and the analogy obvious. Whatever share of success the mercurial ointment may have had in counteracting the canine poison, it has invariably been attributed to the mercury; but I have long suspected it ought rather to have been ascribed to the oily quality of the lard, with which it is compounded, and which constitutes two-thirds of the composition."

"To form a just estimate of the cures attributed to mercury, we must take into the account the other means employed at the same time. Thus M. Baudot, M. Bouteille, and other French practitioners of eminence, unwilling to trust to the above mercurial process alone, expressly order the wound to be first carefully anointed with warm olive oil.

"M. Le Roux and his followers, who rejected mercury, and attributed their success to the antimonial caustic alone, employed nevertheless an ointment, consisting chiefly of fresh butter, to dress the wound †.

"In this and other obstinate diseases of the convulsive kind, the ancients anointed the body with warm oil; a practice too much neglected by modern practitioners.

"Conformable to this idea appears to be Dr. Loof's oleaginous medicine, which now properly comes under consideration. The yolk of egg, though probably destitute of any

\* See *Letters and Papers of the Bath and West-of-England Society*, Vol. IX.

† *Mém. de l' Acad.*, Vol. VI.

specific power, yet (as an animal mucilage well adapted to render the oil miscible with the animal fluids, and also to reconcile it to the stomach) seems a proper addition; nor need there be much exactness from an apprehension of an over-dose. A domestic remedy so simple, so innocent, and so well recommended, is certainly entitled to a full and candid trial in this country.

" That the human body may be thrown into a copious perspiration by friction with warm olive oil, is a circumstance unnoticed till lately. The effects of this process, as practised at the Smyrna hospital, in the prevention and even cure of the plague, in the first stage of infection, are related by Count Berchtold in his late interesting tract on that subject \*; and since confirmed by the testimony of father Lewis, superintendant of the hospital.

" If olive oil, then, be really a preservative against the poison of the incensed viper, and even the pestilential contagion itself, is there not reason to suspect that oil and oleaginous substances may have had a greater share in counter-acting the canine poison than the votaries of mercury ever imagined?

" It is not pretended, indeed, to be a certain, only a probable remedy, after the hydrophobia has actually commenced; analogy affording only a presumption, not a proof; nor can its efficacy be fully ascertained, but by repeated trials and attentive observation. As the prevention depends on due management of the wound, this medicine is judiciously ordered to be applied externally for several days. On this, probably, and this alone, ought the main stress to be laid; yet, to calm the patient's mind, and to strengthen his hopes of security, it may not be amiss to give the oil also internally, according to the directions. Previous to this plan of treatment, however, the wound ought to be diligently washed and cauterised.

" If it cure dogs after the infection has taken place, it is a remarkable circumstance; but still more so, if it effect this by throwing them into a profuse perspiration. This must certainly be a mistake. Dogs, indeed, perspire copiously from

\* *Descrizione del nuovo rimedio curativo e preservativo contro la peste.*  
See Philosophical Magazine, Vol. II. p. 256.

the lungs, but assuredly never from the skin, even in the severest fox-chace.

" As the gastric liquor of a healthy animal has the singular property of counteracting animal poisons taken into the stomach, might not this fluid, applied to the envenomed wound, tend to destroy the activity of the canine poison ?

" As the saliva differs very little from the gastric liquor, may it not, in the act of sucking out the poison, add to the security by subduing any minute remnant lurking at the bottom of the wound ?

" Mr. Whitaker, an intelligent member of the Bath Agricultural Society, has just now favoured me with the following remarkable fact, which tends to corroborate this opinion :— Two persons, very nearly related, had the misfortune to be bitten, at the same time, by a mad dog. One of them, being bitten in the thumb, immediately sucked the wound diligently till the blood ceased to flow ; and, without using any other precaution, remained well. The other, whose lip had been lacerated by the dog, being disabled from sucking out the poison, had immediate recourse to the usual remedy, sea-bathing—and with the usual event. The infection took place ; the hydrophobia came on ; and death ensued.

" As this safe and simple method by suction requires no medical apparatus, can be instantly performed abroad or at home, either by the party or a companion, with little loss of time or delay of business, ought it not to be earnestly recommended to all persons remote from medical aid, particularly shepherds, husbandmen, and agriculturists ? Nor need this preliminary step be any hindrance in prosecuting at leisure the other modes of prevention, which have been considered as most effectual. Were these diligently pursued immediately after every accident of this nature, it is presumed, the hydrophobia would very rarely, if ever, appear. After the proper precautions, therefore, have been duly observed, the patient may be encouraged to banish anxiety, and rest in full assurance of his safety. He may also pursue his usual manner of living, and frequent cheerful company ; abstaining, however, from every kind of intemperance, or being hurried away by

gusts

gusts of anger, or other strong passions. No internal remedies at this period have been insisted upon, because none seemed necessary; nor could they, for reasons assigned, add to the security.

" The canine poison seems to attack the oxygenous principle of the blood, the probable source of irritability and of life. Hence the depressed unequal pulse; the chilliness of the extremities, accompanied with internal heat; the melancholy aspect; the dejection of spirits; and the general absence of fever.

" It appears that the hydrophobia may be considered as a species of spasmodic *angina*, produced by specific contagion, which exerts its influence, 1st, on the injured part, and afterwards on the organs of deglutition: 2dly, That the local stimulus, being propagated to the brain, excites the moving powers of the system into re-action; and hence the convulsive motions which speedily exhaust the strength, and finally extinguish the vital principle: 3dly, That profuse bleeding may prove highly injurious: 4thly, That the forcing down large quantities of liquid is a cruel practice, as it cannot but increase the spasms, and exasperate the malady.

#### *Indications of Cure.*

" The chief indications of cure appear evidently to be the following:—1st, To dissolve the fatal connection between the injured part and the organ of deglutition. 2dly, To calm the violent spasms, and soothe the nervous system. 3dly, To support the strength, and invigorate the whole frame.

" To answer the first of these indications, much depends on external means, and close attention to the injured part. The moment any darting pains, attended with numbness and discoloration, are perceived, they denote the poison to be in an active state, and that no time ought to be lost in prosecuting the most vigorous measures.

" The period from the commencement of these symptoms to the approach of the hydrophobia is uncertain, and perhaps rarely exceeds five or six days. To prevent, therefore, the irritation being propagated to the throat, let the suspected part be immediately cut out, and the surface of the wound duly

duly cauterised. If any difficulty of deglutition has already been felt, let a sharp blister or sinapism be applied to the throat, extending from ear to ear. For, unless the morbid impression can be obliterated by one yet stronger, and the natural action of the sympathising parts speedily restored, there can be but small hopes of success.

" A malady so rapid in its progress, so intractable by nature, demands Herculean remedies, and warrants a prudent trial of the most active substances with which we are yet acquainted. The atropa belladonna, in doses of four or five grains, has been highly extolled by some German professors; the laurocerasus half grain, and arsenic one-eighth by others. The hyoscyamus niger, in form of extract, given in doses of 15 or 20 grains, in cases of fixed melancholy, attended with horrors and obstinate watchings. I have sometimes found very beneficial. It moreover procures sleep and composure of mind; often where opium fails, or even adds to the quietude. Now these potent remedies, with due caution, may be tried in succession: if they fail, they only share the common fate of former antidotes; but if one of them should answer, it may afford an important addition to our stock of knowledge.

" 2dly, To assuage the spasms, and soothe the nervous system.

" To effect this after the hydrophobia has actually appeared, all impediments, and whatever may hurt the acute feelings of the patient, or, by the power of association, tend to aggravate his sufferings, must be first carefully removed; no dog must on any account be allowed to enter the room. Not water only, and other liquids; but all glaring colours, and glass mirrors, must be kept entirely out of his sight. No loud noise, nor cold air, must be suffered to molest him. Having thus removed impediments, we must next endeavour to assist nature in alleviating the spasms and in procuring a lucid interval. If there be any critical evacuation in this disease favourable to our views, it must, I conceive, be that of sweat.

" In the cures recorded by Dr. Nugent and others, in five or six cases of the hydrophobia in an advanced state, the treatment

treatment was different in each; yet there was one circumstance common to all, and that was a copious sweat. Till that appeared, the recovery seems to have been doubtful. Nor is the case described by Van Helmont an exception: the patient being plunged in the cold bath till half dead, the cure was attributed to the fright, but ought rather to have been ascribed to the re-action of the system, which, being aided by a warm bed and sudorific regimen, terminated in a salutary sweat. In a subsequent experiment of this kind, equally terrific, no sweat ensued, and the disease soon proved fatal.

" Sudorifics, indeed, seldom produce a copious sweat, unless their operation can be assisted by warm diluting liquors. Hence, perhaps, it is, that musk, valerian, opium, and other powerful sudorifics, have so often failed. Given merely as antispasmodics, without proper dilution, they serve but to flatter hope at the expence of disappointment; let therefore the following method have a fair trial:

" In a pint of olive oil dissolve an ounce of camphor: let the entire surface of the body be diligently rubbed with this solution, made warm, continuing the friction, before a gentle fire, till the whole be expended; after which let the patient be covered with flannel, and put into a warm bed till a copious perspiration be procured. This may be encouraged by an enema of warm wine-whey, with an addition of volatile alkaline spirit, or *eau de luce*, which last has long been deemed a noted specific in France.—The part affected, and also the neck and spine, ought to be well embrocated twice a-day with tepid oil, which, by soothing the nerves, may act as a powerful anodyne and antispasmodic: could an entire bath of oil be had, it would be, perhaps, greatly preferable to a common bath of warm water.

" A patient, in consequence of the poison of arsenic, had long suffered severe pains and convulsive spasms over the whole surface of his body, which resisted various internal and external remedies, till he was ordered, by M. Bouteille, to be placed, for the space of an hour, at proper intervals, in a bath of warm oil, by which he was soon completely cured.

" If music has charms to harmonise the nerves, and soothe the feelings of a melancholy or outrageous maniac, as mentioned on the highest authority, can any cause be assigned why, in a musical age like the present, its powerful influence should not be tried against this dreadful malady? Though its effects on the disease occasioned by the tarantula may have been greatly exaggerated, yet, if what has been confidently asserted of its efficacy against the envenomed bite of the most dangerous serpents, be true, the analogy would afford, at least, a presumptive argument in its favour. But, independent of this, other beneficial effects, in removing the wild ravings in certain fevers, might here be produced \*. And it was considered by Clinias, Asclepiades, and Aretaeus, as an essential remedy in phrensy, melancholy, and mental derangement.

" In the Memoirs of the Medical Society of Paris, Vol. VI. is an affecting instance of a youth of 12 years old, who died of the hydrophobia. The distressing scene, near the close of the disease, induced the physician to try the effects of music, by playing before him on the guitar. The harmony, even at this late period, we are told, appeased the spasms, and rendered the pulse more calm and regular.

" 3dly, To support strength, and restore the energy of the brain.

" To enable the patient to bear up under the unequal conflict, his diet should consist of the most nutritious aliments, chiefly of the solid kind, to which may be added fresh eggs, jellies, and bread soaked in generous wine. If, from his dread of liquids, neither food nor medicine of the fluid kind can be got down, they must be conveyed in the form of medicated baths and enemas; of which the body, being in a parched absorbent state, will imbibe more than is generally imagined. Might not liquids be also safely conveyed into the stomach with a flexible tube, as in cases of suspended animation?

" To restore oxygen to the blood, and invigorate the whole system, vital air, properly modified, may be inhaled into the lungs. Where this cannot be had, as nitrous acid contains it

\* See *Medical Journal*, Vols. I. II. and XI.

in a loose state, and readily detached, the acid may be diluted with a portion of water, and administered as above mentioned.

"Should any considerable truce to the violent symptoms be happily obtained, the return of paroxysm might possibly be obviated by a liberal use of Peruvian bark with steel, and by repeated oxygenation."

From the variety of facts which we have laid before our readers, it will hardly escape notice, that volatile alkali and olive oil appear to be the most powerful remedies in this dreadful malady; and that the security of the patient would be further insured by the wound being well fucked, and also cicatrised, without any loss of time. . . . A. T.

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## NEW PUBLICATIONS.

*Principles of Modern Chemistry, systematically arranged.* By Dr. F. C. GREN, late Professor at Halle, in Saxony. Translated from the German. Cadell and Davies, 1800. 2 Vols. 946 Pages; with Plates and Tables.

**T**HE better part of the useful arts is chemical. An infinite number of the appearances and changes of material nature are governed by chemical laws: the researches of chemistry conduct to the knowledge of philosophical truth, and form the mind to philosophical enlargement, and accuracy of thought, more happily than almost any other species of investigation in which the human intellect can be employed.

Hence are candid attention and encouragement eminently due to every undertaking which strives, either to extend chemical science by new discoveries, or to recommend and facilitate its study by elementary publications aiming at new precision, clearness, order, fullness, and engaging elegance. From the times of Boyle, Digby, Mayow, and Hooke, to those of Hale, Lewis, Priestley, Black, and Cavendish, the philosophers of Britain, in some measure, slighted chemistry for the sake of those pursuits in the mechanical philosophy and the mathematics, in which they must be confessed to

have been incomparably ardent and successful. Our fathers were therefore content, during that period, to accept the Germans, Dutch, and French, for their chemical instructors. The French, though not the proper authors of the most important discoveries in that which is called Modern Chemistry, were, however, the first to combine, correct, and advance those discoveries into one general system: and we therefore honour them as our masters; and have submitted to receive from them, as well a new chemical language, as our favourite elementary chemical books. Even the Germans, though not more fortunate than we in discovery, nor more ably instructive in academical lectures and the exhibition of experiments, have been lately more forward to publish compilations of the facts and principles of chemical science; and we neither deny praise to their industry, nor reject their aid. Such is the progress of chemical discovery as to demand the frequent composition of new systems, which shall assemble facts as they are observed, and principles as they are established. Books thus necessary we gladly accept, from whatever quarter and under whatever name. We should wish them to be originally in English, to illustrate especially the state of British science, of British investigation, of British arts. But, possess they the true merits which are to be desired of such works in general, we shall receive them with eager gratitude and respect even in translation from a foreign language.

The following abstract of this work, by Dr. Gren, may perhaps assist our readers to judge what utilities are likely to result from the addition of it to the present stock of English chemical literature.

It opens with an introductory sketch of the history of chemistry. In the *first* chapter are explained those more general laws which respect alike all the other parts of chemical science, the general nature of the most remarkable processes of the laboratory, and the forms and peculiar uses of those instruments which chemistry chiefly employs. The chemical history of the more remarkable gases, and of some of their proximate compounds, fills the *second* chapter. The general characters of the acids, of the alkalies, and of their neutral compounds, are exhibited in the *third*. The *fourth* traces

the history of the earths. In the *fifth* the properties of the different mineral acids are explained with considerable minuteness of detail. The chemical composition of vegetables, their principles immediate and ultimate, with their uses in the arts, are the subjects of the *sixth* chapter. The *seventh* chapter is employed upon animal matters. Fermentation and putrefaction are the subjects of the *eighth*. The *ninth* and *tenth* chapters give the chemical history of bituminous and carbonaceous minerals. The metals are the subjects of the *eleventh*. Tables of attractions, specific gravities, weights, measures, &c. fill nine articles of an appendix. A copious index concludes the last volume. A preface by the translator, and a table of contents, are prefixed at the beginning of the first.

Such are the parts, the structure, the exterior form, of this work. Its scientific value is not to be discovered without a more intimate examination of it.

It traces the general history of chemistry from the supposed origin of the science, among the ancient Egyptians, to the æra of its last great improvement by the creation of the anti-phlogistic system.

In the explanation of the first general laws of chemical science, or what may be called the *metaphysics of chemistry*, Dr. Gren teaches, that the attraction, the cohesion, and the expansion of matter depend upon three distinct laws: that matter fills all space, without any intervening vacuity: that it is, however, possible for two particles of matter to exist together in the same space at the same time: that those which are called *permanently elastic fluids* are not condensible nor destructible by the mere abstraction of their caloric: that the affinity of composition, the simple affinity, and the double affinity, are the only distinguishable modes of chemical attraction: that effervescence is no indication of any great activity of attractive force.

Solution, fusion, evaporation, distillation; the subordinate modes of these different processes, and the vessels and implements with which they are usually performed, he describes with considerable accuracy and clearness.

Concerning *caloric*, this ingenious chemist teaches, that

it is elastic and *expansible*: that it is *not expansible*\*: that any quantity of this substance possesses more or less of expansive power, according as it is less or more expanded: that it fills all space, in continuity, without interstices: that it never produces sensible heat without entering into intimate chemical combination with all the parts of the heated body: that its expansive force is sometimes active, sometimes inert and quiescent: that, in vapour, caloric is, though fixed and latent, yet only mechanically adherent to the vaporised substance; while in the permanent elastic gases it is chemically combined with the respective bases: with various other doctrines, which, as less novel and peculiar, require not to be here particularly noticed.

*Light*, this author represents as a compound of a peculiar base with caloric. He supposes it to be rendered fluid and elastic by caloric; to be fixed, without it. He conceives light to exist in a fixed state in all combustible bodies, and to be evolved, in combustion, into combination with the caloric from the vital air that is then decomposed. In this manner he describes *light* as the same thing with the *phlogiston* of the disciples of Stahl; not allowing that, if fixed, it must have gravity, and that, if it have gravity, the bodies out of which it is evolved must be lighter, as to their other matter, after they have lost it, than while it still existed in them. He regards it as being, though a distinct substance from caloric, yet the *matter of heat*, and the *principle of combustion*.

Speaking of *combustion*, Gren scruples not to affirm, that the *antiphlogistic system* affords no explanation of the reason, why a certain degree of previous heat is necessary to the commencement of flaming combustion. *Flame* he describes as essentially consisting of the burning gas of the bodies which are decomposed under it.

He thinks it not improbable that gas-azot and gas-oxygen may co-exist in the atmosphere, not in a merely mechanical mixture, but even in intimate chemical combination.

That *fog* which renders the atmosphere thick, dim, and

\* See the work, Vol. I. § 151. It is possible, however, there may be some mistake in the printing.

turbid, is regarded by Dr. Gren as the basis of aqueous vapour entirely deprived of its caloric.

Dr. Gren regards that which has been called the *oxygenated muriatic acid*, as being nothing but the proper muriatic acid in its full energy. To that which is now commonly called the *muriatic acid*, he gives the name of *muriatous acid*; regarding it as analogous in its character to the sulphureous and the nitrous acids.

He rejects, after Doerffurd, the peculiar existence of the *camphoric acid*. He considers the *narcotic matter* of certain vegetables as worthy to be distinguished as one of their peculiar immediate principles.

The *litbic acid* does not appear to this author to be one that is formed by the organic functions of animals.

He affirms, that those which are called the *acetous* and the *acetic* acids differ only in the degrees of their concentration, not in the proportions of their principles.

His general account of the acids, alkalies, and earths, is indeed brief, and rather incomplete, but in almost every particular sufficiently correct.

According to our personal experience, hot lime and sulphur, coming into intimate contact, are apt to exhibit a combustion of the sulphur, from which ensues a formation of sulphureous acid. Dr. Gren recommends, to prepare sulphuret of lime by mixing chalk with sulphur, and then igniting the mixture, to expel the carbonic acid!

In his account of vegetables, Dr. Gren relates, contrary to the experience of other chemists, that *pyro-ligneous acid*, when sufficiently pure, is, in the nature and proportions of its principles, precisely the same with *acetic acid*!

He ascribes to the mechanical porosity alone, of charcoal, unassisted by any chemical re-agency, that power of purifying saline leys from colouring matters which charcoal is well known to possess.

From accurate analyses of *wheat*, able chemists have resolved this substance into the two immediate principles of *farina* and *gluten*; but Dr. Gren rather considers it as composed of *gluten*, *starch*, and *mucilage*.

He denies that any vegetables have in them such an immediate

mediate principle as *aroma*; but supposes that which has been hitherto called *aroma*, to be merely volatile or ethereal oil.

The plates of the chemical apparatus at the end of the first volume are very beautifully engraved by Mr. Lowry.

Dr. Gren discovers no analogy between the gelly of animal bodies and the gluten of vegetables.

He maintains, that, in *bread*, flour is so thoroughly, so entirely altered, as to be no longer capable of affording even the smallest portion of farina or gluten.

He reckons no substances to be properly susceptible of *putrefaction*, save such as contain *azot*.

Of *bitumens* he asserts, that they must *necessarily* have had their origin from the decomposition of animal bodies.

Though more ample in his accounts of the metals than in the preceding departments of his work, he gives no account of the new Cornish metal the *menachanite*.

At the end the editor has given several useful tables.

As to the other matters in the composition of this work, they differ not materially from the explanations in the systems of Fourcroy, Chaptal, Nicholson, and Jacquin.

The translation is not free from Germanisms; but in books of chemical and physical science, elegance and propriety of this sort are rarely regarded as objects of primary concern.

On the whole, we cannot doubt but the public must receive, with partial favour, a work of such singular merits. The translator, and those who have encouraged the translation, evidently deserve the warmest thanks of British chemists.

*Essays on the Venereal Disease. Part II.* By WILLIAM BLAIR, A.M.F.M.S. &c. &c. &c. Symonds, Paternoster Row. 1800.

IT was some time since stated by Mr. Scott of Bombay, that he had discovered the acid of nitre to possess the powers of a specific remedy for the venereal disease. Dr. Beddoes, Mr. Cruickshank, and other medical gentlemen in this country, eagerly repeated the trials indicated by Mr. Scott. The success was various. One party affirmed the decisive efficacy of the new medicine; another declared, from alleged experience,

tience, that its powers were imaginary, or at best uncertain. Inaccuracy of observation and experiment, with the influence of personal partialities and preconceived opinions, were naturally supposed to be the chief causes of these contrarieties of report. Mr. Blair, Surgeon to the Lock Hospital and Asylum, therefore, undertook to collect such a system of evidence concerning the action of nitric and nitrous acid in *lues venerea*, as should, if possible, finally ascertain the true practical principle in regard to its use. The result of his first inquiries was made public in a former part of the present work. In the second part the ingenious author presents a multiplicity of new testimonies; analyses and examines the facts published on the same subject by others; and endeavours to deduce those general truths, to establish which, he conceives that all his assembled testimonies combine their force. His inquiry has been conducted, and his last inferences are deduced, with the candour of a gentleman and the cautious discrimination of a philosopher. "That the acids of nitre, &c. though very useful auxiliaries to mercury in the cure of the venereal disease, are, in no modification of that complaint, to be confidently and exclusively substituted instead of mercury," is the general practical position with which Mr. Blair closes his whole investigation.

This opinion is, perhaps, the safest to be at present acted upon in medical practice. It seems to be allowed on all hands, however, that nitric acid, taken together with mercury, counteracts its debilitating effects without diminishing its remedial energy.

Of the ratio of the operation of either mercury or nitric acid, as an anti-venereal remedy, no very particular account has ever yet been given. It has indeed been conceived, that, since oxygen is the basis of *vital air*, it must be, in all its various modifications, of sovereign efficacy for the cure of disease and the nourishment of life; that nitric acid is a remedy against *lues venerea*, on account of the oxygen which it contains; and that other oxygenous compounds may probably act with similar effects. All beyond this is still left in mystery. But, is not the venereal virus one of those immemorable and subtle chemical compounds as yet inimitable by

human

human art, which the healthful functions of the animal economy continually form by the endlessly varied combination of hydrogen, carbon, oxygen, and azot? Is not this virus, thus compounded, decomposable, probably, by the affinities of many acid and saline substances, provided these substances might be brought into mixture with it in all those parts of the system in which it is active, and without being themselves previously altered by decomposition or new combinations? Are not the activity with which mercury penetrates throughout the whole body, and that remarkable degree in which, in every one of its combinations, it preserves its primitive energies—are not these the causes of its being a specific for the decomposition and entire expulsion of the venereal virus? Does it not then *certainly* appear, if *oxygen*, or perhaps nitric acid, without decomposition, without new combination, might be brought in sufficient quantity, and for a sufficient length of time, into mixture with all the venereal virus that is at any time in the system, that the virus might be entirely decomposed, and the disease completely healed?

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## INTELLIGENCE,

AND

## MISCELLANEOUS ARTICLES.

## PRIZE QUESTIONS.

**T**HE Electoral Jablonsky Society of the Sciences at Leipzig has announced the following prize questions for the year 1800:

*History.*—A short sketch of the history of the trade of Poland.

*Mathematics.*—An historical view, quoting the authorities of the various purposes to which the laws of attraction have been applied since the time of Newton to the present period.

*Physical Economy.*—Of the influence of the atmosphere on

on the fertility of the earth, according to the newest and most authentic experiments; and in particular, How does the nature of the soil, situation, and culture, contribute to render this influence active and efficacious? The prize is a medal of the value of 24 ducats; and the papers, written either in the Latin or French language, must be transmitted, with a sealed note containing the author's name and place of abode, to C. F. Hindenburg, public professor of natural philosophy and secretary to the society.

The following prize questions have been proposed by the French National Institute.

#### CLASS OF THE MATHEMATICAL AND PHYSICAL SCIENCES.

I. The Class proposed, for the second time, in the year 6, as the subject of a prize, an anatomical comparison of the liver in different kinds of animals; but as no paper has been transmitted on that question, the Class has thought proper to withdraw it, and to propose the following:

"To determine, by chemical and anatomical observations and experiments, what are the phenomena of the torpor which certain animals, such as the marmot, dormouse, &c. experience, during winter, in regard to the circulation of the blood, respiration, and irritability: to make researches respecting the cause of this sleep, and why it is peculiar to these animals."

The competitors are requested to examine in particular what differences are observed between these animals in their lethargic and their ordinary state, in regard to the quickness of their pulse; the degree of the warmth of the blood; the frequency of their respiration; the quantity of oxygen consumed in a given time; and their excitability by galvanism. They will examine also the anatomical differences which distinguish these animals from those not subject to torpor during the winter; and they will endeavour to discover whether these differences are sufficient to explain the phenomena of that torpor.

The prize will be a gold medal of the value of a kilogramme. As the experiments respecting this question can-

not be made but in winter, the memoirs will be received till the 15th of Messidor, year 10. The Institute will proclaim the piece which shall be thought worthy of the prize in its public sitting of Vendemiaire, year 11.

II. The Class proposed also in the year 6, as the subject of a prize, to be determined in the public sitting of Germinal, year 8, the following question :

“ To endeavour to ascertain, by accurate experiments, what influence atmospheric air, light, water, and earth, have on vegetation.”

Though no memoir has been received on this interesting question, the Class has thought proper to propose it again; but as the different labours necessary to resolve it completely would require many experiments and considerable time; and as it can hardly be expected that all the information which may be wished for can be obtained from the competitors in the course of the new term proposed, the Class has decreed, that if memoirs in which the question is treated in its full extent be not received, it will grant the prize to that which shall contain a series of experiments, facts, and observations, that shall appear calculated to augment the knowledge already acquired in regard to some parts of the question.

The prize will be a medal of the value of a kilogramme, and will be decreed in the public sitting of the 15th of Messidor, year 10. The papers must be sent in before the 1st of Nivose, year 10.

III. “ What are the characters which distinguish in animal and vegetable substances those which serve as ferment, from those in which they produce fermentation ? ”

The prize will be a gold medal of the value of a kilogramme, and will be decreed in the public sitting of the 15th of Germinal, year 10. The papers must be sent in before the 1st of Nivose the same year.

#### CLASS OF LITERATURE AND THE FINE ARTS.

“ To analyse the relation which subsists between music and declamation.”

“ To determine the means of applying declamation to music without injuring melody.”

The

The prize will be a gold medal of the value of a kilogramme, and will be decreed in the public sitting of the 15th of Nivose, year 10. The papers must be written in French, and sent in before the 1st of Vendémiaire the same year.

In the sitting of the 15th of Germinal (April 4), at which Bonaparte sat as president, C. Cuvier read an account of the labours of the Mathematical and Physical Class during the preceding three months.

It is in the department of natural history in particular that the labours of the Class, during the last quarter, have enlarged the boundaries of science. It has treated some questions of the utmost importance in regard to the history of minerals and that of animals.

Philosophers, for example, have long been embarrassed with volcanoes, on account of the difficulties which occur in explaining the phenomena of them, and in the attempts made to discover the sources of those immense quantities of substances of every kind thrown up by them during eruptions. C. Patrin, on this subject, has given some views which display a bold imagination, and has called in to his aid all the resources of modern chemistry. He supposes that the water of the sea is continually attracted between the strata of schist, which generally forms the basis of volcanoes: that the marine salt is there decomposed: that its acid becomes surcharged with oxygen by passing over the oxyds of iron and manganese: that it decomposes the fulfures of iron, and even the water, by the intervention of carbon: that the different products of these decompositions, combining under other forms, give petroleum and hydrogen gas, which take fire, and produce the most brilliant part of the volcanic phenomena; while electricity, joining itself to these elements, already so numerous, forms sulphur and phosphorus. It is the last-mentioned substance above all, which, in the opinion of C. Patrin, acts the most distinguished part. By it he supposes the oxygen is fixed under an earthy appearance, and consequently, it is by it that volcanoes are enabled to furnish that immense quantity of lava which they are continually pouring forth on the surrounding districts without exhausting

the base that supports them. In the last place, the iron is carried into the lava by a metalliferous fluid, to which C. Patrin ascribes the property of holding metals in a state of vapour, and of depositing them under certain circumstances, almost as fluoric acid gas does siliceous earth.

Snow of a very bright red colour has sometimes been found on the summits of the highest mountains. The matter which colours it, burns with a smell similar to that of a great many vegetable substances. Saussure, who often collected such snow on the Alps, was induced by this property, as well as by its being found in summer, and in places where a great many plants were in flower, to consider the colouring matter as the farina of some plant\*. C. Ramond, who found this dust on the snow of the Pyrenees, having remarked that it is heavier than water, suspected it to be of mineral origin; and he, indeed, found that it arises from a decomposition of certain micas. This decomposition requires, without doubt, the conditions mentioned by Saussure; for C. Ramond found that they are necessary to the Pyrenees as well as to the Alps.

The production of native metals in the interior of mines is one of those objects also which have attracted the attention of naturalists, and which have given rise to a multitude of systems. An experiment of C. Gillet-Laumont points out one of the ways in which this production may take place. He has shown us, that by touching or rubbing with zinc or with iron the muriat of silver, that is to say, a combination of the oxyd of silver with the muriatic acid, the silver immediately resumes its purity and lustre by giving up its acid to the metal which touches it. But the circumstances necessary for this reduction, which chemistry easily explains, may occur every moment in the interior of mines.

We too often accuse the ancients of error when we do not understand them. Aristotle speaks of the aspalax as an animal entirely blind. The Romans and the moderns, having translated the word *aspalax* mole, thought themselves auth-

\* For an account of Mr. Saussure's discovery of red snow on the Alps, see the Philosophical Magazine, Vol. III. p. 168.

rised to deny the assertion of Aristotle; and indeed the mole is not blind; it is also an animal different from the aspalax. C. Olivier has brought us from the Levant an animal actually blind, its skin not being even pierced at the place where the eyes ought to be; which lives under ground like the mole, and which has all the characters ascribed by Aristotle to the aspalax. This animal is that known to zoologists under the name of *mus typhlus* and *zemni*.

C. Olivier has given us also some information respecting another small animal known to the ancients under the name of the *two-footed rat*, and to the moderns by that of the *jerboa*. The very singular conformation of its feet, of which those behind are five or six times longer than those before, has been known for some time, but we had no accurate knowledge of the manner in which it walks. C. Olivier informs us that it moves forwards only by jumping, but that it always falls on all four. He has described also the organisation of its genitals, which are armed with small points, that must render its copulation still more painful than that of cats. He has described also a small species of this genus, hitherto imperfectly known.

C. Beauvois has invented an instrument for indicating the respective proportions of the crania of different quadrupeds. He has applied it to two animals of North America, which some naturalists still hesitate to make distinct species on account of their great resemblance to animals analogous to them in the old continent. These animals are the fox and the rabbit of the United States. The result of C. Beauvois' comparisons is, that they are two distinct species; and this opinion is justified by the habits of these animals. The rabbit, in particular, does not burrow like ours, but nestles in hollow trees.

C. Latreille has presented two memoirs, which have been since printed. The first treats of the serpents of France. These animals, which occasion so much terror to the vulgar, have not been sufficiently studied by naturalists. The eleven species found in France have often been confounded with each other, but C. Latreille has completely explained the nomenclature,

The second memoir relates to salamanders, to which our ancestors ascribed the property of resisting the flames; but they have shown to our contemporaries a property more authentic, and equally wonderful, that of reproducing their limbs when they have been cut off. C. Latreille has described six species which hitherto have not been distinguished by naturalists.

Every body knows ultramarine, that valuable colour, which alone imitates the azure of the heavens. It is extracted from a stone named *lapis lazuli*, by a very tedious manipulation; and though it has been known for a long time, and was even employed in the middle ages for those miniatures with which manuscripts were ornamented, no precise idea was entertained respecting its colouring principle: it was long believed that it was copper. Margraf proved that it is iron; but the question was, to find in what state it exists in the stone, and how it produces that beautiful blue colour without being combined with the acid of Prussian blue. C. Guyton, treating gypsum which contained abundance of iron, remarked that, in changing itself into a sulfure, that matter assumed a blue colour as unalterable as that of *lapis lazuli*, and preserving itself even in pot-ash in fusion. Guided by this phenomenon, he treated *lapis lazuli* itself; and his experiments leave him no doubt that the colouring principle of that stone is a blue sulfure of iron, which has hitherto eluded the researches of chemists, because they confounded the products of it with those of the grains of pyrites or yellow sulfure of iron, which exist in every kind of *lapis lazuli*. By a few steps more the arts will perhaps be enriched with a rare substance, which may be formed at pleasure.

C. Chaussier has rendered an important service to all those sciences the object of which is organised bodies, by communicating the means of preserving to the different parts of the human body, and of those of animals, the forms which they possessed when in the state of life. This process consists in keeping them for some time in a solution of the oxygenated muriat of mercury, commonly called *corroitive sublimate*. When suffered to dry, after being taken from this mixture, they assume a consistence like that of wood, and become absolutely

absolutely unchangeable in the air. If the bodies have been injected before being immersed, they even retain the colour and freshness of life, and consequently form mummies much more perfect than those of Egypt, which, as has been said, only eternised the image of death. C. Chaussier has no doubt that this was the method employed by Ruisch, and which anatomists in vain attempted to discover.

C. Vauquelin and C. Buniva have analysed the liquor of the amnios of woman and that of the cow, together with the substance found on the bodies of new-born children. The liquor of the amnios of woman contains albumen, soda, muriat of soda, and phosphat of lime. The crust on the body of the foetus is a degeneration of the albuminous substance, which begins to pass to the state of a fat body. The liquor of the amnios of the cow exhibited a peculiar animal matter, a new acid, and sulphat of soda.

Medicine has produced four important memoirs. The epidemic disease which broke out at Nice and Grenoble alarmed the public, and a report was even spread that it was actually the plague. C. Desessart, however, after collecting every information on the subject, has shown that it was only that disease long known under the name of the *jail fever*, which too often attacks armies and other bodies of men when crowded together.

Children are born sometimes with a portion of the viscera uncovered, and having a tumor which by medical men is called an *umbilical hernia*. C. Lassus has shown that the cause of this defect is, that the liver, receiving a larger quantity of blood than it ought by the umbilical vein, dilates itself more than usual, separates the muscles of the abdomen which kept it in its place, dilates and renders thin the tendinous substance that separates them, and makes its way through the same opening of the skin through which the umbilical cord passes. This disorganisation sometimes proceeds so far that the intestines, and even the heart and lungs, are also uncovered. This vicious conformation proves almost always mortal; and C. Lassus announces this circumstance, that surgeons may save themselves the trouble of performing operations, which may cause the parents to be accused of

ignorance or cruelty. C. Pelletan, on the other hand, endeavours to encourage them to undertake another operation, which may be useful, and which misplaced timidity often prevents from being practised; it is that of *bronchotomy*, or opening the tracheal artery. Whenever any body capable of stopping respiration is introduced into that canal, it may be boldly opened, in order to get rid of it.

C. Portal has revived the ideas, which he announced in 1782, on the treatment of that kind of apoplexy called *serous*, that is to say, of that kind during which the face remains pale and livid. He has proved that emetics, generally administered in such cases, are the more ineffectual, as in every kind of apoplexy the stomach is palsied; and that, besides, it has appeared by all bodies which have been opened, that in the serous apoplexy, as well as in others, there are accumulations of blood in the brain. He does not hesitate, therefore, to recommend bleeding for the one as well as for the other; and he has proved by practical observations that it has often succeeded.

C. Duhamel has been employed in improving the art of assaying silver, or of separating it from the lead it contains. For this process, on a small scale, refiners employ small cups of well lixiviated bone-ashes called *cupells*, which absorb the lead as it vitrifies, and leave the silver pure: on a large scale they employ cupells formed of wood-ashes; but, besides their being expensive, they are attended with several inconveniences. C. Duhamel, after remarking that the litharge, or glass of lead, may be separated in proportion as it is formed, without causing it to be absorbed by the cupells, proposes that these vessels should be made of founders sand mixed with clay; that the surface of them should be covered with a stratum of ashes; that the blast of the bellows should be directed on the fluid lead to accelerate the oxydation; and that the litharge should be made to run off by a groove formed in the edge of the cupell, and which ought to be dug lower in proportion as the bath sinks down.

C. Lacepede read an ingenious memoir on some phenomena respecting the flight and vision of birds. He took, as the object of his observations, the eagle and man-of-war bird;

bird; two kinds which are endowed with the strongest power of flight and the acutest vision. It results from his observations that the sight of these birds is nine times more extensive than that of the furthest sighted man; and that in 220 hours, that is to say, in a little more than nine days, allowing them 16 or 17 hours of repose, they would make the tour of the whole earth.

C. Cuvier read the eulogy of Daubenton, with an account of his labours, in the course of which he drew a parallel between him and his friend Buffon. Buffon always suffered himself to be led away by his imagination, Daubenton always endeavoured to guard against his: the former was full of vivacity, the latter of patience: the first chose rather to guess at the truth than to observe it; the second remarked all its details, and was always diffident of himself.

The Class has received from several of its members the following works:

C. Olivier has presented the three first volumes of his *Natural History of Insects*, which contain a description and figures of an immense number of new and interesting species.

C. Brisson presented a new edition of his *Dictionnaire de Physique*, with additions containing an account of all the modern discoveries.

C. Cuvier has presented the two first volumes of his *Lessons of comparative Anatomy*. In this work the author examines the organs of motion and sensation in regard to their structure and uses in man and all the other classes of animals.

C. Levesque read at the same time an account of the labours of the Class of the Moral and Political Sciences during the preceding three months.

C. Gosselin has examined the geographical knowledge of the ancients respecting the southern coasts of Arabia. He has proved that Ptolemy, notwithstanding the singular form he has given to them, has preserved with the greatest accuracy all the distances, and that our best modern charts might be corrected by the labours of that ancient geographer.

C. Buache has communicated to the Class a memoir, in manuscript, written at Cairo in 1717 by the French traveller Paul Lucas. This memoir contains some curious informa-

tion respecting several places in the interior of Africa. The means employed by Paul Lucas to obtain this information were the same as those employed by some late English travellers; he consulted the caravans which set out every year from Cairo for Africa.

C. Langles, by his skill in oriental literature, has been able to procure some information, which he has communicated to the Class, respecting a people in India called the Seeks. These people, whose capital is Lahor, acknowledge as their founder a Hindu born in 1469, who gave them in one book their code of laws and the ritual of their religion. They adore one God, to whom they ascribe neither passions nor human weakness. As they are strangers to the shackles of superstition, they have not received those of despotism, which, by oppressing the other tribes of India, enchains their courage as well as their ideas. As they are industrious, opulent, and brave, and are protected by natural ramparts impenetrable to cavalry, they have never yet been subdued even by the Mogul princes, their neighbours.

ELECTORAL ACADEMY OF THE USEFUL SCIENCES  
AT ERFURT.

In the sitting of September 2, 1799, A. F. Hecker read a treatise on the care and education of orphans; on hospitals for foundlings, and on child-murder.

J. J. Bellermann communicated some observations on five oriental manuscripts which had been presented to the Academy.

C. Cramp communicated his analysis of astronomical and terrestrial refractions.

In the sitting of October 2, Charles Theodore Anthony Maria Baron von Dalberg read a paper on steatites, and the uses to which it may be applied in the arts by lapidaries; and communicated at the same time some observations which he had made on the steatites of Baireuth (*talcum fleatites*). Steatites is an exceedingly soft stone, which can be cut or turned with great ease, and which, when burnt in a close vessel, acquires such a hardness as to withstand the file. In this manner an artist, with very little expence, might prepare cameos,

cameos, gems, and small toys, which in point of solidity would not be inferior to those of the ancients. The author made a series of experiments on the method of giving a durable dye to hardened steatites, by which it appears that it may be made to imitate the most esteemed and most beautiful kinds of stone. In the specimens of the coloured steatites laid before the Society, some of which had heads cut on them, the members admired in particular the high degree of polish of which burnt steatites is susceptible, and in which it exceeds even agate. These experiments are curious, and of the utmost importance to the arts.

Professor J. Bartholomew Trommsdorf gave at the same time a chemical analysis of steatites, by which it appears that siliceous earth and talcous earth are the principal component parts of this fossil. The professor, however, observed also a small mixture of argillaceous earth, which Klaproth, during his researches, did not find, but which, according to the author, was perhaps accidental.

Prince Demitri von Gallitzin gave an account of the experiments which he made with different kinds of air in regard to the germination of vegetables. He sowed garden-cresses in thirteen kinds of air, and kept them all at an equal temperature. The following were the results:—1st, In oxygen gas, and in air corrupted by respiration and burnt bodies, germination took place as well as in common air. 2d, In hydrogen gas and in carbonic acid gas, extracted from different bodies, and by various processes, there was no germination. The seeds of the cresses swelled up a little, but in the course of eight days there was not the smallest sign of growth; though the seeds in atmospheric and oxygen air, and air corrupted by respiration, produced in the same period four leaves. Atmospheric air being admitted into the glasses which contained the carbonic acid, and hydrogen gases, the seeds in forty-eight hours threw out two leaves. From this it seems to follow, that carbonic acid and hydrogen gases check and retard germination, but do not destroy it. 3d, Nitrous air destroyed the seeds, gave them a black colour, and rendered them incapable of germinating in other kinds of air.

This effect, as the author conjectures, arises from the nitrous acid which the nitrous air contains. The author communicated also the following observation:—Being desirous, as the late Camper was, to discover some means for preventing potatoes from growing, in order that they might be preserved in a state fit for food throughout the whole year, he put sixty of them into a glass bell with fixed air, and closed the aperture with mercury. The potatoes, indeed, did not germinate, but at the end of six months they were totally spoiled, emitted a brown corrupted juice, and stunk most intolerably.

Dr. G. H. Thilow read a paper on the action which purified nitre and common salt have on the animal body. From several experiments which the author made in the galvanic manner, with many variations, on different animals, he concludes, that nitre possesses the property of lowering the tone of the nervous and muscular fibres. Thus, for example, the crural nerve of a frog being strewed over with nitre, no convulsive movements of importance took place; but when common salt was applied in the same manner, exceedingly violent convulsions were produced. The author is therefore of opinion, that common salt is to be considered as one of the strongest of stimulants.

In the sitting of November 2, J. F. H. Baron von Dalberg presented a treatise on the origin of harmony, and its progressive formation. In this essay the author traces out the progress of the musical gamut of melody and polyphony, or singing in parts, in the different periods of the history of music from their first origin to their present refined state; and shows, by historical and æsthetic proofs, that all the arts, in regard to their formation, have had the same progress; that is, from simplicity to complexity, from rudeness to refinement, from great to exalted, until the art, by corruption of taste, again sinks into trifling minuteness, and becomes overloaded and spoiled. From these observations the author deduces this practical result for musicians, that unity and variety determine real beauty; that discords, chromatic and enharmonic proportions, the alternation of quick and slow time, and a mixture of the exalted and lively style, are necessary

cessary to enhance the value of consonant simple proportions; and that variety in the unity, order, and symmetry of the parts, alternation, and contrasts, and power combined with softness, form the eternal laws of æsthetic beauty. The author at the same time presented several illustrations, and a few curious unpublished songs of the middle ages, with the old mode of notation in the form of cyphers, or the Hebrew accents, part of which he brought with him from Italy.

The president, C. F. Baron von Dacheröden, director of the Academy, presented an urn, dug up a short time before near Straßfurt, the height of which was six and a half, and the width at the greatest diameter nine inches. The president observed, as something remarkable, that this Germanic urn was found, with several others, in a low district, though the burying-places of the ancient Germans were always on eminences. Near this urn were found several masses of stone, which seem to indicate a Druidical altar or habitation.

Professor H. A. Frank read some observations which contained a criticism on a supposed proof of hereditary diseases. Some person having asserted in a late publication on hereditary diseases, that the Roman families of Piso, Cicero, Lentulus, Fabius, &c. acquired their names from certain spots, marks, or moles, resembling different kinds of pulse, which were peculiar to them, and which were transmitted through different generations, the author shows that Plutarch and Pliny, who speak of the derivation of these names, partly do not make the above assertion, and partly are of another opinion. Thus, Pliny deduces the above names from this circumstance, that those to whom they were first given distinguished themselves in a particular manner by the cultivation of pulse.

Professor Joseph Hamilton read a paper on the nature of the electric matter. He is of opinion that this matter consists of light, fire, and the phosphoric acid.

Dr. G. Thilow presented some observations to confirm the discovery of Ingenhouz, that oxygen has a great influence on vegetation. The author's experiments were the two following:—1st, A weak, sickly dwarf-tree was besprinkled with a mixture of oil of vitriol and water. The tree-lice, which rendered

dered the plant sickly, afterwards disappeared, and the plant speedily revived. 2d, A small layer of an auricula (*Primula auricula* Linn.) by the same means, in the period of scarcely three weeks, was brought to a considerable size and full bloom. This plant the author presented to the Society. The latter experiment, according to the author, would probably have succeeded in a shorter period had not the expansion of the plant been retarded by two nights frost.

In the sitting of December 3, Professor J. B. Trommsdorff read a paper entitled Collections towards a Chemical Knowledge of Mineral Bodies; which contained, 1st, A chemical analysis of a black feld spar in the basaltes of an extinguished volcano of Unkel: 2d, The anatomy of a blue chalcedony from Siberia: 3d, The decomposition of a dark black obsidian stone from Mount Heckla: 4th, The chemical examination of a heliotrope from Bohemia.

A paper was received from N. Müller, of Marktwipfeld, on the progress of distilling spirits from potatoes according to the author's principles; in which he endeavoured to show that the country around Nieuwied had derived great benefit from this method of distillation, and from its becoming more general.

#### HEAT AND LIGHT.

By Dr. Herschel's experiments on this subject, and which have been laid before the Royal Society, it appears, not only that the different coloured rays of the solar spectrum are endowed with very different powers of heating bodies; but that heat also comes from the sun by *invisible rays*, which are *less refrangible* than the red rays of the prismatic spectrum,

#### ANTIQUITIES.

A peasant of Steyermark, a few months ago, in digging at the large canal near Vienna, found an urn containing 298 pieces of the purest gold, of a straw colour, somewhat smaller than Imperial ducats, but twice as thick, and consequently equal in value to about an English guinea. Twenty of these pieces he immediately gave to one of his fellow-labourers, and with four others he purchased from a Vienna pedlar some clothes, with which, and the remainder of the coins,

coins, he set out for Steyermark. Here, however, the circumstance was discovered by the magistrates, and 274 of the coins have since been transmitted to the Imperial cabinet. Twenty of these pieces are still wanting, but the Austrian government is making search after them. All these coins are in excellent preservation, but a few of them are a little cut. They comprehend 76 of Nero; 95 of Vespasian; 42 of Trajan, two of them exceedingly well preserved; 21 of Adrian; 10 of Antoninus; 12 of Domitian; 11 of Lucius Verus; 9 of Galba, three of them exceedingly good; 1 of Marcus Aurelius; 1 of Marciana; 8 of Faustina, three of them in fine preservation; 8 of Otho, and 1 of Æmilius.

The proprietors of an enclosure near Montpellier, in lately digging up a plantation, discovered a tomb in which was enclosed an alabaster urn, the cover of which was cemented down. On opening they found in it ashes, an alabaster incense-pot, the handle of which represented the head of a ram, a sepulchral lamp, and several pieces of money struck in the reign of Domitian. Another discovery for the amusement of antiquarians has also been made in France—a temple has lately been found which was dedicated to Ceres, and which, according to history, was situated on the road from Paris to Chartres.

#### A NEW EARTH.

Professor Trommsdorff has announced that he has discovered a new simple earth in the so called Saxon beryl. "I examined," says he, "this fossil, and expected to find in it glucine, but could discover no traces of it. The new earth which I found possesses the following properties, by which it distinguishes itself from other earths:—It is white, and totally insoluble in water. In a fresh state, when moistened with water, it is somewhat ductile. In the fire it becomes transparent and very hard, so as to scratch glass, but remains insipid and insoluble in water. The burnt earth dissolves very easily in acids, and produces with them peculiar salts, which are entirely void of taste. Fixed alkalies dissolve this earth neither in the dry nor the wet way; and it is equally insoluble with the carbonic acid and with caustic ammonia. It has a greater affinity to the oxalic than to other

other acids. I have given to this earth the name of *agust erde* (tasteless earth) because a combination of it with acids is insipid." Professor Trommsdorff informs us, that a full analysis of this earth, accompanied with an accurate description of the fossil by Dr. Bernhardi, as well as an analysis of a German fossil that contains chrome, will appear in the first part of the eighth volume of his Journal of Pharmacy, along with other essays of importance to chemists.

#### LEARNED TOUR.

A letter from Rome of a recent date contains the following article:—"Mr. Hamilton, a young man twenty-five years of age, nephew to Sir William Hamilton, the British ambassador at the court of Naples, and secretary to the British ambassador at Constantinople, is about to undertake a learned tour through Greece, Asia Minor, Syria, and Egypt. With this view, during his residence in this city, he engaged various artists, to whom he is to allow handsome salaries. He takes with him as architect an Italian named Baiestra; a statuary, also an Italian, is engaged merely for the purpose of superintending the casts; as models of all the monuments not transportable are to be taken on the spot. Don Tito, of Naples, is to attend Mr. Hamilton, as landscape-painter, and to design ruins; and the Calmuc Feodor, an ingenious draftsman and engraver, who about eight years ago was sent by the court of Carlruhe to Rome, but who was left there several years without any protection, and who on that account was in narrow circumstances, is engaged to paint figures. These artists are all engaged for two or three years. Mr. Hamilton proceeded from Naples to Palermo, and thence to Constantinople, where he passed the winter, that he might begin his tour through Greece in the spring.

"Besides the above artists, Mr. Hamilton carried along with him from Naples a band of music. The whole travelling party, after they have been joined by some English gentlemen of fortune at Constantinople, will consist of from sixty to eighty persons."

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# THE PHILOSOPHICAL MAGAZINE.

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MAY 1800.

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I. Description of the Island of Celebes or Macassar; with an Account of its Gold Mines, and the Manner of working them. By Mr. VON WURMB\*.

THE island of Celebes, called also Macassar, is of great importance to the Dutch † for the spice trade, on account of its situation, as it has on the north the Philippines, on the west the Sunda isles, on the east the Moluccas, and on the south Timor and Java. It extends from the third degree of north to the fifth of south latitude, and lies nearly under the 136th degree of longitude. It is about a hundred and twenty miles in length from north to south, and forty-five in breadth from east to west. Raynal says its diameter amounts to about a hundred and thirty miles, by which, in all probability, he understood its length from north to south. Properly the eastern side of the island is called Celebes, and the western Macassar; but in general the former name is given to the whole island, particularly by the Dutch.

As this island lies under the line, the air is exceedingly hot; but the heat is moderated by frequent rains and cooling breezes, and in most places the air is not prejudicial to the health of the inhabitants. It abounds with moun-

\* From *Merkwürdigkeiten aus Ostindien*, published by his brother.

† This island, since the author wrote, has fallen into the hands of the English.

tains, but the soil, taken in general, is fertile. Rice, coco-nut trees, mangoes, bananas, melons, and oranges, grow here exceedingly well, and are cultivated in abundance, together with the cotton shrub, *uby*, and *batta*\*. There are here also plenty of horses, oxen, buffaloes, deer, wild swine, and birds of all kinds, and in particular a variety of beautiful parrots. Abundance of fish are caught on the sea-coasts as well as in the rivers and lakes.

The Dutch carry hither opium, spirits, lack, coarse and fine cloths, &c. and receive in exchange rice, wax, slaves, and gold. Here, as well as in many parts on the coast of Africa, the unfortunate beings doomed to slavery are not prisoners taken in war, or criminals, but people in general who have been kidnapped for the purpose of being sold; and it often happens that relations do not hesitate, for the sake of gain, to deprive their fellow-creatures of liberty, the greatest blessing which mankind enjoy in the present life. The island is well peopled: on the coast of Celebes alone there are said to be fifty-six thousand inhabitants, seventeen thousand of whom are capable of bearing arms.

In this island there is a multitude of small kingdoms and states, the greater part of which, however, depend on the two great kingdoms of Macassar and Bony. The king of Ternate, also, has extensive possessions, which occupy almost the whole of the northern and eastern part of Celebes. The two most powerful kings, whom the Dutch, by the preponderance of their arms, obtained as allies, are the kings of Macassar and Bony. The kings of Tello and Sandrabony are in alliance with the king of Macassar; and those of Soping, Luhu, and Tanette, with that of Bony. Some small states, such as Wadjo, Mandhaar, &c. are independent. Though the kings of Macassar and Bony are allies of the Dutch, they are always sworn enemies to each other; and this is not unfavourable to the policy of the Dutch, who in their Indian possessions still keep in view the maxim *divide et impera*, and

\* *Uby* is a root used as food, and *batta* is a kind of buck-wheat, which formerly was the chief food of the Javanese before they were acquainted with the use of rice.

who derive great advantage from the discord of the eastern princes.

The kingdom of Macassar or Goach lies on the western side of the island, of which it occupies the greater part. The king of Goach and that of Tello both bear the title of Macassar, though each has a distinct kingdom: they assume the titles of Goach and Tello from their places of residence. According to an ancient tradition, the Macassars, like many other nations, deduce the origin of their princes immediately from the gods. Once, say they, after the death of the first sovereign of the kingdom, a beautiful female descended from heaven suspended by a golden chain. This celestial beauty, named Tumanurong-a, was immediately chosen by the Macassars to be their queen. She afterwards married a king of Bonthain, and, after being pregnant three years, brought forth a wonderful child, capable of speaking and walking as soon as it was born, but exceedingly ugly and deformed. This young prince was named Tuma-Salingabeerang. When he attained to manhood he broke the golden chain which his mother had brought with her from heaven, and the mother and her husband instantly disappeared, and left to their son the kingdom, together with one half of the chain. This chain, which, it is asserted, was sometimes light and sometimes heavy, and sometimes appeared of a pale colour, was long preserved as a valuable part of the regalia of the crown, until it was lost, with various other rarities, during the war-like commotions which took place in this kingdom about the middle of the present century. This Tuma-Salingabeerang is considered as the chief of the family of all the kings of Goach.

The Dutch were involved in violent disputes with these sovereigns before they were able to establish themselves in their kingdom. In the year 1778 Goach, the capital, was taken by storm and destroyed; and in 1781 the present king Punduca Siri, sultan Abdal Hadja, was placed on the throne by the government of Batavia. The king of Goach does not enjoy unlimited power, but is subject to certain laws, which he is obliged strictly to observe. He can undertake no measure of importance without the consent of his council, nor

can he inflict arbitrary punishment on criminals, who must be punished according to the laws. He has a privy council called *Tonulalangs*, and every village is under the direction of a particular governor distinguished by the title of *Galarang*.

The Portuguese visited this island about the beginning of the sixteenth century, and obtained from the sovereign then on the throne permission to form an establishment. The successors of this prince introduced the weights and measures now in use, fixed the prices of merchandise, manufactured gunpowder, and planted the first cannon on the walls of Goach. He gave permission also to the Malays not only to reside in his kingdom, but to erect a Mahometan temple. This religion made such progress here, that about the year 1588 deputies were sent to Mecca to bring from thence a hadja or priest to instruct the Macassars in the doctrine of Mahometanism, which in 1603 was established throughout the whole kingdom under the sultan Allahudier.

The kingdom of Bony, which lies on the western side of a bay, called on that account the Bay of Bony, is the second kingdom in point of importance in the island. It is in close alliance with the two small kingdoms of Soping and Luhu. The natives of Bony, that they may not appear inferior to the Macassars, deduce their origin in the like manner from the gods. The first king, they say, descended from heaven, and was known by the name of Matta-Solompo-e, that is, the all-seeing. This sovereign, after reigning forty years, resigned the kingdom to his son, and with his wife ascended again to heaven: but, notwithstanding this common descent of their rulers from the race of the gods, the Macassars and people of Bony are sworn enemies, and their incessant quarrels greatly contributed to enable the Dutch, who, according as their interest required, favoured sometimes the one party and sometimes the other, to make themselves masters of the island. At present the Bouginefe, or people of Bony, are the most powerful, as the Macassars were about a century ago.

The Bouginefe are of a middle stature, and have a brown complexion, but not dark. Among the female sex, in particular, some are found almost entirely fair. Their features in general are agreeable, only that the nose is a little flattened.

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The Macassars, on the other hand, are of large stature, have a manly warlike appearance, are of a more open disposition, and at the same time detest treachery; while their opponents, the Bouginese, never attack openly, but endeavour to fall upon their enemies by surprise. Those even who never did them an injury are not secure from being murdered by them when they can do it with privacy; and they often commit such actions for no other reason, as they say, than to try the goodness of their daggers. Many Macassars, as well as Europeans, have fallen a sacrifice to this thirst for blood. Their daggers and assagays are for the most part poisoned, as well as their small darts, which they can shoot at their enemies to a considerable distance by blowing them through a tube.

Their clothing consists of a piece of red or blue cotton cloth wrapped round the body, and drawn through between the legs. The upper part of the body is quite naked. On the head they wear a piece of cotton cloth in the form of a handkerchief, with which they cover their hair, which is as black as pitch, and exceedingly long. On the other parts of the body neither the men nor the women suffer any hair to grow; they pull it out by the roots, in the same manner as the Mahometans and Indians, as soon as it appears. They feed for the most part on rice, fish, and pisangs; and their Beverage is water, though they are not destitute of *sagueer*, or palm wine. The Bouginese women are in general much handsomer than those of the other Indian tribes: some of them, had their complexion the same mixture of red and white as our females, would be accounted beauties in Europe. They are naturally of an amorous disposition, and are capable of undertaking any thing to gratify their inclinations.

The Mahometan religion, which has here become general, permits the Bouginese to have four lawful wives, provided the husband can maintain them. If the parties, however, are not satisfied with each other, they may separate with as little trouble as they were united. Their funerals are attended with very little ceremony. The body is wrapped up in a piece of white cotton cloth and deposited in the grave, over which some sweet-scented flowers are strewed, and two stones are erected, one at the head and another at the feet. The

Bouginele

Bouginese have a sort of game at cards, which in all probability they learned from the Portuguese. It has a great similarity to that called *tarocco*, though the twenty-two tarocs are not among their cards. The four colours are called *spada*, *datudyens caso slokke*, *copas-cousel*, and *boelang-rofy*.

As the Dutch readily saw the great importance of this island, particularly in regard to their spice trade, they did every thing in their power to form a settlement in it, and even at an annual expense, which considerably exceeded the income arising from their trade: the abbé Raynal makes it to be 165,000 livres. The castle of Rotterdam, which is the principal residence of their East India company in the kingdom of Macassar, lies in the latitude of  $5^{\circ} 7'$  south, and the longitude of  $136^{\circ} 50'$ . It was constructed by the Portuguese with the assistance of the Macassars, and was afterwards beautified by the Dutch, who increased its fortifications. Some years ago a neat church was erected here capable of containing two hundred persons. The walls of the fortrefs, which are strong, and of considerable height, are built entirely of stone hewn from the rock. On coming out by the land-gate you arrive at a large plain, on the north side of which lies the village of Blaardingen, where the principal part of the Europeans reside. The streets, which are broad, and ornamented with beautiful buildings, intersect each other at right angles in the direction of the four points of the compafs. At the end of one of them is a large edifice set apart for an orphan-house. The Chinese all live together in one street, called for that reason the Chinese street. Blaardingen is surrounded with palisades, and is furnished with gates, which are shut in the night-time. Without the palisades, towards the south, there is a row of buildings, one of which is the habitation of the governor, and at a little distance there are some places called *campongs* inhabited by natives and Europeans.

The road of Macassar is one of the most beautiful in India, and at the same time safe for ships at every season of the year. The district around it is exceedingly pleasant. It consists of a large plain several miles in extent, in which, as far as the eye can reach, nothing is to be seen but rice-

fields and meadows watered by small streams. The picturesque appearance of this scene is heightened by groves and scattered clumps of shady trees loaded with fruit. Towards the east it is bounded by lofty mountains, called the mountains of Bonthain, which divide this part of Celebes towards the west from Bony, and towards the south from the gulph of Tomini into two parts.

The seasons are here the same as in Java. The south-east monsoon continues from May till November, and is called the favourable monsoon: the north-west, called the bad monsoon, continues from November till May. During the former the sky is serene and the weather dry; but continual winds and violent rain prevail during the latter. It is very singular, that on the east side of the before-mentioned mountains of Bonthain the contrary takes place: for, when fine weather in the south-east monsoon prevails on the west side of the mountains, there is nothing but hurricanes and rain on the east side; so that the boundaries of summer and winter are only a few miles distant from each other. The principal productions here are rice and cotton. The rice, however, is inferior in quality to that of Java, but the cotton is the best in India.

The Dutch East India company possess the castle of Rotterdam, called in the language of the country Adjong Pandang, together with the surrounding district, in consequence of a treaty which they entered into with the prince of Celebes. But as the boundaries of their possessions were perhaps not accurately defined, the company always endeavoured to enlarge, and the Macassars on the other hand to confine them. The company possess also a peninsula extending from this place towards the north, and a large flat district, which, on account of its fertility, is considered as the granary of Celebes, together with several places lying between this plain and the mountains, and likewise a great many villages among the mountains. These places border on each other, and are bounded on the west by the sea, on the north by the kingdoms of Tanette and Maros, on the east by Tamari, and on the south by the kingdom of Macassar. The inhabitants

of them, after various revolts, were at last reduced to complete obedience in 1738.

I shall omit saying any thing of the other small kingdoms in the island of Celebes, and proceed to a description of its gold mines, and the method in which the gold is collected. Mining and the art of metallurgy are conducted in a very careless manner in India; which is owing partly to the ignorance of the natives, and partly to their indolence. In general it needs excite little surprise, that people who live in a mild climate, and who have few wants, should be little inclined to penetrate into the bowels of the earth to procure metals, which are immediately extorted from them by the avaricious Europeans, or of which they are in a great measure deprived by their own princes. If an Indian here and there be compelled by force or necessity to dig for or collect gold, he never goes to work with sufficient intelligence and activity, but contents himself with what he can procure to satisfy his wants in the easiest and speediest manner. This is exactly the case with the Indians who inhabit those parts of Celebes which produce gold.

They obtain that metal by collecting the small particles which have been carried down by the streams, or by washing the sand which they dig up, rather than by working the mines in a regular manner. The auriferous mines in the island of Celebes commence on the southern side of Bulang and the northern side of Kotta-Buna or Mogondo, and proceed thence to Dondo on the south-west, and Tamperana on the north-west side, at the Bay of Tomini. Every where between these two districts gold is found in a greater or less quantity. Where the land of Celebes becomes so narrow, and the mountains so low, that a person can with ease pass from the one coast to the other in a few hours, the auriferous mountains end; and on the whole coast on the other side, as far as Macassar, a single gold mine is not to be found.

Besides the mines already discovered, a great many others would no doubt be found, were there a sufficiency of labourers; for the villages in these auriferous mountains are exceedingly ill peopled. Another cause of these treasures being

so much neglected is the ignorant superstition of the natives. They never will venture to dig in any place where they suspect great riches to be concealed until they have sent thither a diviner, as he is called; to find out whether their labours will be attended with success. The whole art of these diviners, called in the language of the country *Talanga*, consists in their discovering, as they pretend, by the voice of a certain bird, whether abundance of gold is to be found in a certain place; whether the labourers will be attacked by sickness; whether there are in it many spirits to impede the labourers and conceal the gold from them, with other things of the like kind. If the bird gives a favourable answer to all these questions, the diviner must endeavour to secure the favour of the protecting spirits of the place by offerings of various kinds; after which a few workmen may begin digging, and continue their labour as many days or months as the bird has prescribed. If the bird, however, gives an unfavourable answer to only one question, no person will venture in such a place to dig a hole of only a few inches in depth. Many rich mines remain, therefore, unexplored, because the prophetic bird, or the *Talanga*, are not in good humour.

When the workmen have arrived at the place where, according to the permission of the *Talainga*, they may dig up gold, they hold serious counsel with the bird once more, and ask it in what particular spot they must begin. When this is done, they first conduct water to the spot; for without water they cannot proceed, as by its means they wash away the earth and clay from the pit, that the stones and fine sand, among which the gold is contained, may remain pure. If the situation of the ground will not admit of the water being conducted in furrows, they make a kind of gutters of hollow *wakka* trees, which they support with props. When they have brought the water to the place where the mine is to be worked, they make a pit of twenty, thirty, or forty feet in circumference, according to the number of workmen: sometimes there are eight, and sometimes ten or twelve. As long as the water has room to run off, they suffer it to carry with it the earth, which they keep continually turning and stirring in the pit; but when the pit becomes so deep that there is

no passage for the water, they must bale it out till they arrive at the stones. These they wash clean, and build them up regularly around the sides of the pit, but without lime or mortar, to prevent the earth from falling in. When the pit is carried to a very great depth, they secure these stones by means of boards and beams of wood. These poor miners find sometimes stones of from three to four and five hundred weight, which they are obliged to raise and remove from the pit without any other machines than a common wooden lever.

When all the earth, clay, dirt, and stones have been thrown from the pit, and a kind of black sand begins to appear, they are then sure that they shall find gold. This sand they take up in a kind of small shovels made for the purpose; and, having placed themselves in the water, they put one handful of the sand after another on small round wooden dishes named *dulangs*. These *dulangs* are about eighteen inches in diameter and somewhat hollow, and have a small cavity in the middle which can be closed with a wooden cover. When all the sand has been washed from the *dulang* by being continually stirred round with the hand, the gold, which is much heavier, remains in the above-mentioned cavity. When it can receive no more, they take the gold which has been collected, and hold it over the fire in a coco-nut shell till it is dry; after which they blow away the remaining sand as well as they can, and preserve the pure gold.

When they dig a hill or mountain which is situated close to a river, they employ another method to obtain the gold. In this case they make a pit at the edge of the river, conduct into it as much water as they have occasion for, throw into it the earth they have dug up, and wash it till nothing remains but the black sand mixed with gold; after which they wash it in their *dulangs*, as already described. This is the easiest method of procuring gold, provided it can be employed. They have, however, a third method; but it can be used only in mines newly discovered. They go into the river with a basket on their back, and a piece of iron resembling a thick chisel, which has a wooden handle, and search the fissures and crevices of the rocks, where they sometimes find lumps-

of gold equal in weight to two or three rials. In other respects, the art of digging for gold is the same in all the mines and among all the people on this coast. The only difference is in regard to the depth of the pits. In many places it is scarcely necessary to go deeper than ten or twelve feet; but in others the pits must be carried to the depth of several fathoms, and the sides must be supported by means of boards and beams. The instruments used in these mines consist only of a piece of iron about a foot and a half long and two inches in thickness: it is pointed and sharp at the one extremity, and at the other is furnished with a socket, into which is stuck a wooden pole about six feet in length. Those who are able to procure it have also an iron hook, with a short wooden handle, which they employ for loosening and turning up the earth around stones. A mattock, with the above-mentioned *dulangs*, which each miner makes for himself, and a pair of gold scales, form all the rest of their apparatus.

When a gold mine is discovered, the workmen do not immediately begin to dig it, but first search the nearest river, in which they turn up the stones and drain off a part of the water. After they have turned up the sand to about the depth of a foot, they sometimes find large pieces of gold, which in all probability have been washed down by the streams from the mountains. It has been remarked that the rocks on the borders of rivers, and even the greater part of the stones which are taken up from pits where the ore is rich, have a blue, and sometimes yellow, colour, and are so soft that they may be used as paint. Where the gold is less rich, the stones are gray or white, and either of a hard texture, or soft like limestone. By these signs the produce in gold of any mine may be easily ascertained.

In all the gold mines, but particularly those which lie at a distance from the shore, it is exceedingly cold before sunrise and after sun-set. On this account the poor miners suffer a great deal. As they are obliged to sit in the water from morning till night, their bodies, when they cease from their labour, are almost rendered quite white by the saltpetre. When the mines are worked, the water of the river near which they are situated is muddy, and of a reddish-yellow

colour down to its mouth ; and those who are so imprudent as to drink of it are seized with a dangerous dysentery.

The labour of the miners is not always attended with the same success ; for it sometimes happens that they work a month and longer, during which they spend several dollars, without finding gold of the value of one. In that case they are obliged to dig in some other place, and to renew their labour. In newly discovered mines they are for the most part successful ; but in mines that have been worked for some time, they are often obliged to labour a whole month before they obtain any gold. The quantity and value of the gold which is found in any mine cannot be accurately ascertained. One workman, also, is often more fortunate than another. In newly discovered mines there are labourers who sometimes, in the course of fourteen days, find to the value of two hundred dollars ; whereas in other places the value of twenty dollars is scarcely found in the course of a year.

In the wide extended gold mines of the river Palella, which divides itself into several branches, there are places where gold is exceedingly abundant ; but in such places it is of less value, being scarcely eighteen carats fine. The best gold comes from the mines of Popajatu, Molisipat, Ankahulu, Tolodinki, Lembuno, Sonsso and Tamperana ; also from the south and south-west side of Pogiana, Wongo, Tomollas Bevool, and Tontoly. The gold procured from all these mines is for the most part above twenty carats fine. Frederick Dühr, a servant of the Dutch East India company, who visited these mines a few years ago, is the only person who has given an authentic account of them. Those who travelled through these districts before him, never saw the gold mines, but only visited the habitations of the chief civil officers, which are at a considerable distance from the places where the gold is dug up ; and the chief men among the natives are too indolent to undertake journeys along those difficult and dangerous roads which conduct to the mines, and in which people are often in danger of breaking their necks.

Within the extent of the gold mines of Ankahulu there is a place called Longi, which produces a kind of gold that in fineness

fineness exceeds even that of Popajatu and Ankahulu. This place, however, is little frequented, because the small river near which it is situated is not navigable, and the inhabitants are obliged to carry their provisions on their backs along a difficult and dangerous road. Besides, the miners often find in this place a great deal of copper, which, when they have no acid to put it to the test, often deceives them, as they at first take it to be gold. This is the only mine on the north or north-west side where copper is found. Near Bevool, on the south or south-west side, there is another where good copper is dug up in dust, which is as fine as the finest gold-dust. In the mines of Bombula, Batodulang, Ankahulu, and Palella, a great deal of rock-crystal is found, and likewise a kind of iron ore.

In almost all the mines which the before-mentioned Mr. Dühr visited, he observed, that the workmen, when they had dug to the depth of five, and in some places of twelve feet, came to a horizontal stratum of rock, which with their instruments they were not able to penetrate. They, however, frequently told him, that they firmly believed that they should find gold below these rocks, if they could break through them. He saw also at Ankahulu, where a stratum of such rock is found, at the depth of from twelve to fifteen feet, that there were fissures in it, two or three inches wide, which contained a blackish substance almost like rust of iron, mixed with a great many pieces of gold, and which the workmen, after they washed the rock perfectly clean, dug out to as great a depth as they could with their tools. In all the mines of Celebes, the gold, when separated from the sand, is of considerable fineness. At Pogiama and Palella alone gold ore is found here and there, mixed among other stones; but it is not rich, and the gold must be extracted by pounding the stone, which is not very hard.

*II. Observations on preserving Specimens of Plants.* By  
JOHN STACKHOUSE, Esq. F.L.S.\*

**I**N prosecuting my researches with a view to complete the history of the British *Fuci*, I was desirous to discover, if possible, a method of preventing the olive-coloured, coriaceous species from turning black in drying. For this purpose I tried the experiment of immersing them in a strong solution of alum. The result of my experiment did not answer my expectation. They were prevented, indeed, from turning black, but they acquired a greenish hue. However, imagining this might arise from the mixture of alumina with muriatic salts, and being of opinion that the properties of alum might be of great use in preserving land plants on several accounts, I set on foot a course of experiments, and am happy to say, that the result has been favourable to my expectations. After repeated trials, during which partial failures occurred, owing to the proportioning the degrees of strength of the solution, and the admission of light and air during the time of drying, I can safely recommend to the public attention the process which follows, not doubting but that many improvements will suggest themselves to those who possess a chemical knowledge of the various substances made use of by dyers in fixing their colours.

Take a saturated solution of powdered alum in common water: immerse carefully your specimen, flowers, leaves and stalk in this liquor. During this immersion, with a camel's-hair brush, such as varnishers make use of, wet thoroughly a sheet of blotting-paper: display your specimen carefully on this paper, and prepare another sheet in a similar manner to lay over your plant. Then give a smart pressure to your plant, either with a botanical press, a napkin press, or weights of any kind applied to the specimen placed between smooth boards, or books, observing to lay about half a quire of paper below the specimen, and the same quantity above, to take up the moisture. After a day or two, according to

\* From the *Transactions of the Linnaean Society*, Vol. V.

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the succulence of the plant, and when the aluminated paper appears perfectly dry, your specimen may be removed into fresh paper, and kept carefully under gentle pressure, with the edges of the paper folded over each other to prevent every possible admission of light and air till its removal into the herbarium. For those who wish to affix their specimens. (and it is scarcely possible to effect the preservation of the delicate tints of the petals of many kinds without a strong adhesion to, and almost incorporation with, the paper,) the time above mentioned, that is, when the aluminated paper is thoroughly dry, is the proper time for proceeding with the operation. Have ready a paste made with flour and water, with alum mixed in it, such as upholsterers use, strong gum-water, or isinglass-glue: apply either of these to the back of your specimen with a brush; then fix it carefully on strong writing or drawing-paper, by laying your paper smoothly on the specimen as it lies, pressing it gently with your hands and a cloth, and then turning over both together. When this is done, iron the plant with a box-heater in the manner recommended by Major Velley in Dr. Withering's *Arrangement of British Plants*, v. 1. p. 34, if you have the conveniences; if not, apply an immediate and smart pressure, as before directed.

It is taken for granted that those who wish to profit by these instructions, are practised in the usual methods of preserving dry specimens, and that they are aware that particular care should be taken to pare off the back parts of thick woody stalks, and of the globose, succulent heads of flowers, as well as of the buds of those intended to be pasted down, previous to their pressure. For the most satisfactory information on these particulars, the reader is referred to the Introduction to Dr. Withering's excellent work above mentioned. It is almost needless to mention, that aluminated specimens will be completely guarded from the erosion of insects, as well as from the danger of being injured by damps; and therefore the process will be particularly valuable to those who visit foreign countries.

As beauty and durability are of so much consequence in the arrangement of an herbarium, and as plants cannot be preserved

preserved any length of time in perfection even with the usual apparatus of a *vesculeum*, or tin-case, no botanical traveller should be without a small press, such as that described in Dr. Withering's *Arrangement*, v. 1. p. 31. It may be framed so as to admit of a drawer for receiving the preserved specimens; either thin enough to lie under the feet in a post-chaise; or, as a seat for a third person is often desirable, it may be contrived to be as high as the seat of the carriage, with a corresponding cushion on the top.

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### III. A cursory View of some of the late Discoveries in Science.

[Continued from Page 251.]

#### ANATOMY OF ANIMALS.

**C**UVIER has made many researches respecting the organisation of insects, and the manner in which nutrition takes place among them. "I think I am the first," says he, "who has distinguished worms into two grand families; the moluscae, which have a heart, and a complete system of circulation; and zoophytes, which have neither. I have described the heart, and the vascular system of the principal genera of the moluscae; and I have proved that their venous vessels perform at the same time the function of absorbing vessels." He then shows that insects have neither a heart nor vessels of circulation. Malpighi observed in the silk-worm a large knotty vessel extending along the whole back, and he believed that this vessel performed the functions of the heart and aorta, and that the same organisation existed in all insects. This opinion was adopted by all naturalists. Cuvier has carefully examined this vessel, as well as the whole organisation of insects; but he observed no movement of fluids, or circulation. Almost the whole body of the insect is filled with tracheæ; from which he concludes that there is no real circulation in these animals, and that their nutrition is performed by immediate absorption, as is evident in polypes and other zoophytes, which are found immediately below insects in the scale of organic perfection.

He then examines the organisation of the medusa or sea-nettle, and shows that it approaches near to that of vegetables. "If I confined myself," says he, "to announcing, that there exists an animal without a mouth, which is nourished, like plants, by means of ramified suckers, and in which the stomach supplies the place of heart, one might have some right to refuse assent to so extraordinary an assertion; but I exhibit the animal itself." He then explains the nature of its organisation. This animal has no mouth, but only some *ostioles*, or very small apertures, which all terminate at a large cavity or bag, which may be considered as the stomach. From this cavity proceed sixteen vessels, which are distributed to every part of the animal, and have a communication with each other by means of a circular vessel exactly concentric to the contour of the animal. These vessels serve to convey the nutritive juice. No heart is observed in this animal, nor any organ analogous to one.

Cuvier has compared also the brain of various red-blooded animals. The character of that of man and apes is, the existence of the posterior lobe and the digital cavity. The character of the brain of carnivorous animals is, the smallness of the *nates* in regard to the *testes*. In herbivorous animals the *testes* are much larger than the *nates*. That of the brain of rongeurs (the stag kind) is the size of the *nates*, and the absence or shallowness of the circumvolutions. That of the brain of the solidipedæ is the size of the *nates*, joined to numerous and deep circumvolutions. That of the brain of cetaceous animals is its great breadth in proportion to its length, and the total absence of olfactory nerves. Man and quadrupeds alone have olfactory nerves properly so called: in real quadrupeds they are supplied by mammillary caruncles.

Sue has described the manner in which he prepares the skeletons of animals. He first boils them in water, as was practised by Daubenton; after which he pours water over them, or throws it upon them with force from a syringe. By these means all the flesh detaches itself from the bones, which remain perfectly clean.

Dumeril has observed, that the last articulation of the fingers in mammiferous animals always retains a peculiar

character in each species. He proposes to give to this articulation the name of the *os unguinalis*.

#### ANIMAL PHYSIOLOGY.

Léveillé has given a very curious work on the manner in which young oviparous animals are nourished in the egg. He compares it with that in which nutrition is performed in the foetus of mammalia, and shows :

1. That the foetus of mammalia is nourished only by the umbilical cord, and that it receives no nourishment by the mouth : that the same thing takes place in the young oviparous animal enclosed in the egg ; and to prove it, he gives the anatomy of the egg, and of the membranes which envelop the foetus.
2. That the egg, when incubated, consists of the eye (*cicatricula*), the yolk, three distinct albumens, an absorbing canal, five membranes, sanguine and serous vessels.
3. That the third albumen is divided into two parts, united by a very thin prolongation : that their position is not at the two opposite poles of the yolk, and that each has for its centre an annular cordon ; in one of them it is membranaceous, in the other vascular.
4. That there exists a communication between the albuminous mass and the capsule of the yolk, by means of this absorbing conduit.
5. That the yolk has no suspending ligament, and that it floats at freedom in the interior of the white.
6. That the volume of the albuminous mass decreases in proportion to the time of incubation, while that of the yolk increases ; which seems to prove that the one absorbs the other.
7. That the first albumen having no communication with the other two, there is reason to presume that it is absorbed by the vessels of the sacciform membrane. It is this which is cemented to the shell of the egg, except at the broad end.
8. That the yolk, besides its augmentation of bulk, has very great fluidity ; and that it is absorbed by the vascular membrane, which forms its proper tunic.
9. That it is proved by experience that there are no yellow vessels

vessels nor valvulae in the interior of the *chlorilime* membrane; that is to say, that which encloses the yolk of the egg.

10. That the chicken, considered as foetus, is enveloped in a peculiar membrane, that separates it from the yolk, with which it has a connection, and from the white, with which it has none, and from which it is at a considerable distance.

11. That all substances destined for the nourishment of this foetus are contained in distinct capsulae separated from it.

12. That there exists a perfect analogy between the vessels of the yolk and those of the placenta; and that the former are to the yolk what the second are to the matrix, except the difference in the circulation.

13. That, contrary to the opinion of Haller, the albumen does not communicate with the aquous bag; and that the chicken makes no use of this fluid for its nourishment.

14. During the latter period of incubation, every thing left enters into the abdomen of the chicken in such a manner that no umbilical cord remains without.

15. That the red-blooded animals, which live in air, may be divided into two grand classes, the umbilical and non-umbilical.

Dr. Jenner has made an interesting discovery in regard to the cow-pock. He observed that cows were subject to pustules on their teats. Those who milk them acquire pustules also; and it is very extraordinary that by these means they are preserved from the small-pox. He inoculated with the cow-pock in the same manner as with the common small-pox, and by these means produced the same effects as when people acquire the disease by touching the pustules of cows; that is to say, these people are not liable to the common small-pox, either by communication or inoculation. These facts have been confirmed by several other physicians, such as Drs. Pearson, Pulteney, &c. Dr. Woodville, physician to the Small-Pox Hospital, has inoculated in this manner several hundred persons. This discovery is of the utmost importance to humanity; for it is well known that the natural small-pox is one of the most destructive of all those diseases

which afflict mankind. Inoculation, therefore, ought no longer to be performed with the matter of the common small-pox or variolous matter, but with the vaccine; because inoculation with the latter is free from all danger, whereas that with matter of the common small-pox is attended sometimes with fatal consequences.

Herholdt has proved that the liquor of the amnios penetrates sometimes into the tympanum of the foetus; from which he concludes, that it introduces itself sometimes, also, into the tracheal artery, and fills it before birth. When the child is brought forth, it is necessary, therefore, to assist that liquor in flowing off. Nature generally operates in this case alone; but its efforts are sometimes ineffectual, and the child is supposed to be still-born. In such circumstances it must be assisted. This the author did in thirteen children, whom he restored to life by facilitating the escape of the liquor.

Dr. Buvina has made experiments which tend to prove, that in living animals the red blood is retained in its proper cavities by the active vitality of the parts, rather than by the smallness of the vessels and pores. This he proved by making injections of blood. These injections in the living animal penetrate only to the vessels, in which it circulates during life. This he proved in a living calf; but, having deprived the animal of life by cutting the spinal marrow, the injections immediately penetrated to the most delicate vessels of the periosteum and other parts, and gave them a red colour, which they have not in the living animal. He has even seen the blood issue from wounds, such as those of vesicatores. He thence concludes, that if the blood in the living animal does not penetrate to several delicate vessels, such as the lymphatic, it is on account of the resistance opposed to it by the force of vitality, and not on account of the smallness of the orifice of the vessels. The spontaneous echymoses, which take place in the scurvy and some other diseases, seem to arise from the weakness of the vital forces, which permit the blood to penetrate to the capillary vessels.

The same author has demonstrated, by direct experiments, that a portion of the bone of a body, newly deprived of life,

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may be engrafted on the bone of a living animal of the same or of a different species.

In conjunction with Vafalli, he has made experiments to ascertain whether the opinion of the ancients, who pretended that contagious diseases are produced by insects, be true; but their researches have shown them that this opinion has no foundation.

Pinel has published numerous observations, which he has had occasion to make, on idiots and maniacs. He shows that kind and gentle treatment, but attended with firmness, often calms the fury of those unfortunate persons, and is frequently sufficient to restore them to reason.

#### PHYSIOLOGY OF VEGETABLES.

Desfontaines has given a memoir on the cultivation and uses of the date-tree, so valuable to the inhabitants of hot countries. These palms, as is well known, are of the family of the *diœcia*, the male flowers of which are borne on one stalk and the female flowers on another. The male flowers, destined for fecundation, are detached from the trees about the end of March, before the antheræ have shed their farina. They are prepared in such a manner that they can be tied to the females: they are hung up and dried in the shade; and in this manner they will retain their virtue till the year following. Towards the end of April they are attached to the female date-trees, which are thus fecundated; because it would be very imprudent for men, whose whole nourishment is confined to the fruit of this palm, and who inhabit the bosom of the deserts, to trust for the fertility of these trees to the winds, which, in some cases, may convey the fecundating farina.

Linnæus made known a part of the wonderful phenomena exhibited by the *valisneria* at the time of its fecundation. Picot la Peyrouse has added some new details. This plant belongs to the *diœcia*. The male and female always grow at the bottom of the water. At the moment when the male is about to flower, its stalks, which are terminated by a flat sheath, burst, and the flowers are thrown out on the surface of the water; where they unite, and float about at the pleasure

sure of the winds. The females, which have a very long stalk, turned into a spiral like a spiral spring, rise at the same time to the surface of the water by the expansion of their stalk; agitate themselves around the male flowers, which approach them; and when the rays of the sun begin to heat the horizon, the stalk falls back, and carries with it, below the water, the female flowers, which then shut. But in the evening, as soon as the sun sinks below the horizon, they reappear on the surface of the water. This is repeated several times, but the author has not determined the number. In the last place, when the fecundation is effected, the stalk falls back entirely, and carries with it, to the bottom of the water, the flower and the germ.

Coulomb having caused to be cut down, towards the end of April, some Italian poplars covered with flowers, observed that one of them, which had been cut at the distance of some lines from the axis of the tree, emitted at the cut a noise like that produced by the air when it issues in abundance, and in small bubbles, from the surface of a fluid, and that a great deal of sap flowed from it. This experiment, being repeated several times, was always attended with the same success; from which he concludes, that the sap in large trees does not ascend in a sensible manner, but towards the axis, which forms the medullary canal. To ascertain this fact, he caused several of these trees to be pierced with a gimblet; but the instrument was scarcely moistened till it had arrived within two or three centimetres of the centre of the tree: when it approached the centre, sap issued in abundance, with a continued noise of air-bubbles, which ascended with the sap, and burst in the orifice formed by the gimblet.

Saussure the son has published researches on the influence which oxygen gas has on the germination of plants. The greater part of naturalists, says he, who have examined the influence of atmospheric air on germination, have perceived, that when seeds are placed in contact with water and pure azotic gas, they do not germinate; and that there is a production of carbonic acid, which, mixing itself with the azotic gas, increases the volume of the atmosphere of the plant. They have seen that, when oxygen gas is substituted in the preceding experiment,

experiment for azotic gas, there is also a production of carbonic acid gas; but that the atmosphere of the plant decreases, and that the oxygen gas is absorbed. He made several experiments to discover what takes place in these operations. The following are his conclusions:

1. The atmospheric oxygen gas is not absorbed by the seed in the act of germination, as seems hitherto to have been admitted, but is employed merely to form carbonic acid gas with the carbon of the seed.

2. The seed in germination does not, by the contact of the atmospheric air, form carbonic acid gas from its own substance, but only furnishes one of the constituent parts of that gas, *viz.* carbon.

3. It furnishes the oxygen and carbon from its own substance in the carbonic acid gas, which it produces when it is in contact only with water and pure azotic gas.

Though the action which the vegetation of plants exercises on atmospheric air has been examined by a great number of philosophers, much on this head is still wanting. Spallanzani, who has been lately snatched from the sciences, has also examined this subject. He concludes from his experiments:

1. That the leaves and tops of vegetables, when the rays of the sun dart upon them, increase the proportion of the oxygen gas of the atmospheric air.

2. That this augmentation is not so considerable as has been believed.

3. That the same parts of vegetables diminish the oxygen gas during the night, and cloudy days, by transforming it continually though slowly into carbonic acid.

4. That the flowers, whether in the sun or shade, have more power to diminish the quantity of vital air or oxygen gas.

5. That fruit have the same effects in this respect as flowers.

Delaville has examined several plants which afforded him sugar; such as the mallow, digitalis purpurea, cabbage, the leaves of the artichoke. The beet-root gave also a large quantity.

Desfontaines has published his excellent memoir on the structure of the monocotyledons, or plants with one seminal leaf, such as palms, asparagus, rushes, &c. He has shown that

that the whole of the interior of these plants is composed of the medullary part, in the middle of which are a few longitudinal fibres. These vegetables have no solidity but at the surface, where the fibres are collected and united; whereas in the dicotyledons the surface is composed of an epidermis, which has little solidity, while the interior has a great deal.

Though the green matter which vegetates in water has already been the object of much research to philosophers, Senebier has thought it worthy of being subjected to a new examination. He informs us, that it was known to Lahire, Leuenhoeck, and Homberg. Adanson gave it the name of *tremella conferva gelatinosa, omnium tenerrima, minima, aquarum limo innascens*. Priestley, Ingenhouz, Senebier, Girod-Chantram, made a variety of experiments and observations on this singular substance. Felix Fontana believes it to be a kind of polypier, that is the habitation of small insects, which produce it as other insects produce coral. This is the opinion also of Ingenhouz and Girod-Chantram; but Senebier is of a different opinion. Having made researches respecting the manner in which this green matter is produced in the water, he found, 1. That it was never produced in water kept in obscurity: 2. That a great deal of time was requisite to produce it in distilled water, and that it was necessary that the water should be long exposed to the air: 3. That water into which he had put earth, was more favourable than any other to the production of this green matter: 4. That none of it was formed in a vessel of water covered with a stratum of oil.

To ascertain the manner in which it is formed, he put glasses, on which some of the green matter had been, into vessels of water, and perceived in the water, some days after, animalcula without green matter. The green matter then appeared, and he saw the animalcula penetrate into it, and give it movement. At other times he saw the green matter without animalcula. He observed in this green matter a very distinct pellicle, similar to that of vegetables. This pellicle appeared to him to absorb the carbonic acid gas which is in the water; to decompose it; to absorb the carbon; to nourish itself; and to suffer the oxygen gas to be disengaged.

This pellicle appeared to be the fundamental body of the green matter; it is a kind of net-work, or tissue.

He observed also, with great care, the animalcula generally found in the green matter, and it appeared that they were not different from those of common infusions. This much however is certain, that the same animals are not always found in the green matter. He mentions the experiments of Muller on infusion animalcula, and shows, that the same kind almost are found in the green matter. He shows further, that the green matter, examined with the microscope, exhibits nothing that can be considered as a polypier, or nest of small animalcula. From all these observations he concludes it to be probable, that the green matter is a real vegetable analogous to the *ulva intestinalis*, or *nystock*; that the animals most frequently found with it do not belong to it, since the green matter may exist without animalcula; and that these animalcula are often found without the green matter: so that, in every respect, the green matter and animalcula appear to be absolutely independent of each other: the green matter must be a plant on which the animalcula feed.

The green matter, kept in water in an obscure place, seems to dissolve. It becomes gray, white, and gives no more air when exposed to the sun. A chemical analysis of the green matter proves also that it is a vegetable, for he extracted from it gum, resin, and a portion of green colouring matter: a small quantity of ammonia has indeed been procured from it, but several plants, when analysed, give the same; and besides, this green matter almost always contains the remains of animalcula and other animals, which might have furnished ammonia. His conclusion is, notwithstanding every probability to the contrary, that this green matter is a plant: further observations and experiments respecting it are necessary.

He next directs his researches to conservæ, and examines the opinion of those who believe them to be the matter of zoophytes; that is to say, a kind of nests, or madrepores, containing the insects which form them. All his observations have proved to him that this opinion is not well founded, and he consequently persists in believing, that the conservæ, as well as the green matter, are real vegetables.

Girod-Chantram has made observations on different kinds of conseruae, but chiefly the *rivularis* and *fontana*. He maintains his first opinion, and believes these productions to be the habitation of animals.

Decandolle has examined, with Brogniard, the structure of marine plants, such as the *fuci*; he finds that they have a great affinity to the conseruae.

Morellot has given observations on the leaves of trees, with the signs which announce their being in full vigour, and the time when they ought to be collected for pharmaceutical and economical purposes. He shows that it is at the period when the plant is in flower that the leaves possess their full virtue. They drop when their particular life is terminated.

[To be continued.]

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#### IV. On the Effects of the Acetic or Acetous Ether, employed with Friction in the Rheumatism, Sciatica, and Gout.

**T**HE different changes of weather from cold to heat, and from dry to moist, which succeed each other so frequently and so rapidly, often give rise to the rheumatism; a malady exceedingly painful, and for which medicine affords too few remedies. If acetic ether, therefore, as appears, speedily allays the pains, and even cures them, the application of it is a new benefit to mankind, which ought to be made known that it may be brought into general use.

About twenty-five years ago, when the acetous ether was discovered in the laboratory of Count de Lauragais, it was not employed in medicine. In 1784, C. Sedillot jun. being tormented with the rheumatism, tried on himself this acid, pouring twelve or fifteen drops, at different times, on the part affected, which he immediately rubbed with his hand, to render the action of the remedy more penetrating. After this friction, he kept himself warm in bed: a perspiration took place at the part which had been rubbed, and soon became general, and the pain was sensibly diminished. Twelve hours after, a second friction produced the like effects;

effects; and a third, after the same interval, made a complete cure. C. Sedillot says he repeated this experiment afterwards on a great many persons, and that it always succeeded. He recommended it, therefore, to the notice of medical men in the Transactions of the Medical Society of Paris \*.

C. Martin, physician to the hospital of Narbonne, and formerly physician to the army of the Eastern Pyrenees, has lately confirmed, in a memoir read before the Medical Society †, the properties ascribed by C. Sedillot jun. to acetous ether. He employed it also, with friction, in several cases of people tormented with the rheumatism, sciatica, and gout. Among these cases, he quotes one of a man fifty-five years of age, who had been long subject to rheumatic pains which had no fixed seat; and who, having been attacked with a violent sciatica from the hip to the extremity of the foot, could obtain only very slight and momentary relief from all the other remedies, both internal and external, which were administered to him. Half an ounce of acetous ether was applied in friction, every twelve hours, over the whole of the part affected; and after each friction he kept himself warm in bed. After the third friction he found relief; and at the sixth he was so well cured that he went next day to his country-seat, a league distant from the city, although three days before he had not been able to drag himself from one end of his chamber to the other without experiencing the most excruciating pain. Successful cases of this kind, communicated to the Society of Medicine at Paris by a regular practitioner, deserve the attention of medical men, who ought to try the remedy in order to ascertain whether its efficacy be such as is here stated.

C. Sedillot considers acetous ether also as a sedative much speedier and gentler in its effect than opium: it does not tend, he says, like the latter, to impede the action of the organs. The following is the result of an experiment which he made with it on himself:—Six drops on a lump of sugar

\* No. X. Messidor, an. 5.

† See *La Recueil de la Société de Medicine*, Vol. VIII. No. 48, Germinal, an. 8.

produced no sensible effect; next day, twelve drops induced a slight propensity to sleep; and the day following, eighteen drops rendered this propensity still greater. By thus adding six drops to the dose every succeeding day, always with sugar, he swallowed half a grain on the sixth day, which produced a profound tranquillity and necessity of sleep.

It is recommended to those who employ this remedy to use pure acetous ether; but it is to be observed, that it is not easily met with in that state. The following is the process for preparing it, prescribed by C. Sedillot:

Take equal parts (for example, a pound) of alcohol, and another of acetous acid. Distil this mixture in a glass retort, and the result will be the acetous ether; which must be rectified to free it from the superabundant acid which has passed over with it in distillation. For this purpose put it into a glass vessel, into which introduce a solution of the carbonat of pot-ash (salt of tartar): this alkali absorbs the acid, and the ether floats on the surface. It is then decanted, and rectified by a new distillation in a glass retort with a suitable apparatus.

#### V. *On the Nature of the Colouring Principle of Lapis Lazuli.* By C. GUYTON\*.

CHEMISTS have long made that blue stone, known under the name of *lapis lazuli*, an object of their research, with a view, in particular, to discover the colouring substance which gives it so high a value; on account of the splendour it communicates to works in which it is employed, and of the ultramarine, so much esteemed in painting, which is prepared from it. This colour was first ascribed to copper; but the celebrated Margraf demonstrated the fallacy of this opinion, as he found in it only filex, sulphat of lime, lime, and a little iron. Some after him suspected in it the presence of the oxyd of cobalt; and others, such as Kinmann, a little fluoric acid: but all these conjectures, by a more accurate examination, were soon shown to be false.

\* From the *Annales de Chimie*, No. 100.

The means of analysis having, for some years past, been carried to a degree of perfection which could scarcely have been expected, it was natural to think that the chemists most expert in this new art would not neglect to apply it to the solution of this important question. Among this number I shall mention Mr. Klaproth, whose labours have so much enriched the chemistry of minerals, and who has paid particular attention to all the blue-coloured fossils. In 1784 he published experiments which demonstrate that what is called native Prussian blue, a substance found in turfey soil, and which is often white before being exposed to the air, derives its colour only from a combination of iron and the phosphoric acid \*.

Another mineral, remarkable for the same colour, which has been successively taken for smalt, or the native blue oxyd of cobalt; for another kind of native Prussian blue; and for a blue oxyd of copper, was discovered at Vorau in Austria. But it results, from the examination of it by the celebrated chemist of Berlin, that the colour depends only on filex, argil, and iron; and though he discovered that it resisted the action of the fire less than lapis lazuli, he is of opinion that it might be classed among the number of its varieties, if it should be found to contain also lime †. This last conclusion shows that Mr. Klaproth had previously determined, with his usual accuracy, the constituent parts of the real lapis lazuli; and he indeed indicates them in the tenth article of his Researches on Mineral Substances; where we see that the purest lapis lazuli, called *oriental*, consists of 46 per cent. of filex, 28 of carbonat of lime, 14.5 of argil, 6.5 of sulphat of lime, 3 of oxyd of iron, and 2 of water.

He rectified, therefore, the analysis of Margraf, by adding argil; of which the latter made no mention, and which I showed, fifteen years ago, to be contained in it, by touching a polished piece of lapis lazuli with the sulphuric acid, which at the end of some hours left very regular crystals of alum, that remained on it. But by what principle can the oxyd of

\* *Chemische Annal.* 1784, p. 396.

† See *Beytrage zur kritniss der mineral korper, &c.* Vol. I. p. 197, and *Annales de Chimie*, Vol. XXI. p. 144.

iron be tinged blue without a combination either with the prussic or the phosphoric acid? Mr. Klaproth says that he does not know\*.

The experiments of which I am about to give an account seem to me to afford a solution of this important question: but before I present the processes and the results, I ought, for the sake of perspicuity, to give an account of some labours, which paved the way for arriving at this conclusion. In the year 1780, when inspecting a pit in search of coal at Montolier, in the road from Dole to Poligny, I found, at the depth of 35 metres, a gypseous bed containing zones of a beautiful very bright red colour. I gave a description and analysis of it in the *Jurnal de Physique* for the month of December that year, and I concluded from my experiments that it was sulphat of lime coloured by the oxyd of iron.

The recent discovery of several new metallic substances, some of which had the property of giving colours of great intensity, induced me to think that the fossil of Montolier deserved to be again examined with a view of searching for one of these oxyds. For this purpose, at the commencement of this year, I destined a piece of it for the experiments in the analyses of minerals, which form part of my course at the Polytechnic School. They were conducted with as much precision as sagacity by C. Desormes, formerly a pupil in the laboratory of the second division. Having ascertained that this fossil contained no carbonat of lime, we took ten grammes of it, reduced to powder, which was put in a crucible and brought to a red heat. The colour became darker, and passed to a yellowish-brown, and there was a loss in the weight of 2·23 grammes, or 22·3 per cent.

A. We digested, at several times, the muriatic acid on the 7·77 that remained after calcination; they did not lose their colour, and the acid took up only a very small portion of the iron.

B. We afterwards boiled the residuum in a solution of the carbonat of pot-ash, but only a very small part was decomposed.

C. What remained was mixed with charcoal dust, and

\* See his *Beytrage, &c.*, Vol. I. p. 204.

treated in a crucible. A fulsire being formed, it was decomposed by the muriatic acid, which seized on the lime and the iron, while the filex remained mixed with the superabundant carbon.

D. The liquors arising from the three operations were united, and then divided into two equal portions. From the first we separated iron, which was found to weigh 1.05 grammes; and I assured myself that it contained no other earth but lime. We drew from the second 8 decagrammes of lime. The whole liquor, therefore, contained, according to the proportions determined by Klaproth,

Oxyd of iron	- - -	2.1	grammes.
Lime	- - -	1.6	
Sulphuric acid	- - -	2.91	

E. It remained to examine the portion of earth left by the acid, and which was found mixed with the superabundant carbon. Here the operations began to present those unexpected phenomena, which, deviating from the ordinary course, inform the attentive chemist that he is advancing towards a discovery. This residuum was first calcined in an open vessel to consume the carbon, but the filex remained black: it weighed 1.65. It was treated with pot-ash in a crucible of platina, and gave a fused mass of a superb blue colour. Water poured over it assumed the same colour. The nitric acid made it entirely disappear. The filex, separated by evaporating to dryness, weighed no more than 0.86 grammes.

F. It now became of importance to know the effect of different re-agents on the nitric acid which had been poured over the mass fused in the crucible, with a view to discover the substance that had given it these properties. The following are the results of these trials:

1. With the prussiat of pot-ash this liquor gave a precipitate of a yellowish-green colour, which the addition of acids, instead of converting into blue, made immediately disappear.
2. With the gallic acid there was no precipitate.
3. With sulphurated hydrogen there was no precipitate,

as might have been expected, looking only for iron ; but it was proper thus to exclude the other metallic substances, which are precipitated by this re-agent.

4. With the hydro-sulphure of ammonia there was a beautiful green precipitate.

5. With ammonia, a white precipitate.

6. With pot-ash, a light blue precipitate.—The two last passed to yellow in drying.

Comparative experiments were made at the same time with a solution of the nitrat of iron, and the results were totally different.

G. That no doubt might be left respecting the nature of the substances, the presence of which might have had an influence in these results, synthesis was called in to the aid of analysis. Sulphure of iron was prepared in a direct manner ; the nitric acid was poured over it in sufficient quantity, and the liquor, when filtered, was diluted with abundance of water, that the excess of the acid might no longer precipitate the sulphurated hydrogen which was poured over it. In this state the same re-agents which had been before employed presented all the same phenomena. One might have supposed that the sulphat of iron, (not oxydated,) in the same circumstances, would have given some analogous effects ; but the prussiat of pot-ash produced only a white precipitate, as professor Proust had announced.

H. It was easy, after this, to conclude the analysis of the red sulphat of lime of Montolier : it confirmed what I had announced, that it depended only on the oxyd of iron ; and, besides, determined with accuracy the quantities of the constituent parts as follows :

Sulphuric acid	-	-	-	-	-	-	29.1
Lime	-	-	-	-	-	-	16.0
Oxyd of iron	-	-	-	-	-	-	21.9
Silex	-	-	-	-	-	-	8.6
Water carried off by the first calcination	-	-	-	-	-	-	22.3
Lofs	-	-	-	-	-	-	2.1
							<hr/> 100.0

But

But the termination of this labour opened a field for new researches, of which it is time I should give an account also.

I. Observing the blue colour which the sulphat of lime of Montolier had assumed with pot-ash, the effects of the reagents on the acid holding its iron in solution; and, above all, seeing the green precipitate formed by the prusiliats disappear by the addition of acid, C. Desormes recollects that he had observed similar phenomena during some experiments which he undertook last year with C. Clouet on lapis lazuli. This was already a strong indication that this stone contained some other colouring metallic oxyd than that of iron. The question then was, to follow the coincidence of facts in all its circumstances, to determine the particular state in which this metal produces that beautiful blue composition. Some experiments added to the observations already known respecting the properties of lapis lazuli will give an idea of this coincidence.

K. Lapis lazuli may be brought to a red heat, and lose as much as 0·2 of its weight without any sensible alteration in its colour; but at a stronger heat, such as that of an enameller's furnace, its colour passes to grey. By still increasing the intensity of the heat, it is reduced to a brownish vitreous scoria, and there is a decrease of from 10 to 11 hundred parts of its weight.

L. When lapis lazuli is pulverised, one sometimes perceives a smell similar to that of musk, and which argil and magnesia emit also when they are united with a little sulphur.

M. Lapis lazuli is deprived of its colour by the three mineral acids, but more or less speedily. This effect, by the nitric acid, is produced almost instantaneously: the muriatic acid is the next in order: the action of sulphuric acid is the slowest. The same odour is often disengaged from it by these acids as by trituration.

If the nitric acid is concentrated, there is a production of nitrous gas; and, accidentally, of carbonic acid gas when the lapis lazuli contains carbonat of lime. The liquor tried by prusiliats gives a precipitate, the colour of which approaches that of Prussian blue, but inclining sensibly to green, and

which is destroyed by acids. The hydro-sulfure of ammonia occasions in it a green precipitate inclining to black. When the nitric acid is used diluted with water, there is a disengagement of a little sulphurated hydrogen. Prussiats then form in the liquor only a bright green precipitate, which acids cause immediately to disappear. With the hydro-sulfure of ammonia the precipitate is a beautiful green. If the lapis lazuli has been previously subjected to calcination, diluted nitric acid disengages from it a little sulphureous acid gas.

N. These facts prove, not only that the lapis lazuli holds a little sulphur, but they demonstrate also the identity of the colouring principle of this stone, with every composition in which earthy substances are made to enter in combination with the sulfure of iron, since we have seen (F, G,) the sulphat of lime, holding iron, carried to the state of sulfure by carbon, and the sulfure of iron, prepared in a direct manner, present the same phenomena under the same circumstances.

O. Before I terminate this memoir I shall add some observations, which will be of utility to those who may be disposed to repeat these experiments,

The composition of every kind of lapis lazuli is not essentially the same: one may perceive very distinctly in several specimens, even of that called the oriental, sulfure of iron in crystals which have metallic brilliancy. Sometimes it is disseminated in small particles; and it is this, no doubt, which has hitherto prevented the most accurate chemists from detecting the real colouring principle of this substance. They have seen the sulphur as an accidental production foreign to the subject of the analysis, without suspecting that there existed a blue sulfure of iron. It may readily be conceived that, in experiments of this kind, the greatest care must be taken to choose fragments absolutely free from every particle of pyrites or sulfure of iron, of a yellow metallic appearance.

The presence of this last sulfure is not the only difference found between specimens of lapis lazuli. Of three kinds subjected to examination, one contained, with crystallised sulfure of iron and blue sulfure of iron, only sulphat of lime and filex. The second, besides these, contained barytes; and the third,

absolutely

absolutely free from all mixture of pyrites, had in its composition argil and carbonat of lime similar to that analysed by Mr. Klaproth.

The crystals of alum, which were formed very speedily, as already mentioned, on a beautiful plate of lapis lazuli, leave no doubt that there are some kinds in which a little pot-ash may be accidentally contained. It will be proper, therefore, to search for the colouring principle in what constitutes its real essence, without paying too much attention to these accidental varieties. We must not, however, believe that the affinity of earths, either with each other, or with the colouring principle itself, has any influence on the nature of the compound. A proof of the contrary here presented itself, in a sensible manner, in one of the synthetic operations. Sulphat of lime charged with iron having been treated with charcoal-dust, and then held in digestion in the nitric acid, the prussiat of pot-ash at first only coloured the liquor green, without giving a precipitate: the addition of a solution of argil immediately produced a green precipitate, which was taken up by acids, and, under all circumstances, exhibited the same phenomena as that obtained from the decomposition of lapis lazuli.

The consequences which appear to me to result from the facts announced in this paper, are as follows:

1. The sulphat of lime of Montolier is coloured by a red oxyd of iron, which adheres so strongly to filex as to resist the action of acids.

2. This sulphat, treated with carbon, gives birth to a sulfure of iron, in which that metal is less oxydated; which being dissolved in acids, does not by prussiats give Prussian blue, but a green precipitate, which acids destroy instead of heightening, and which retains the blue colour peculiar to it even in pot-ash, and at that heat which is required for its fusion in the dry way.

3. By operating on the sulfure of iron prepared in a direct manner, you obtain a product which manifests the same properties in the same acids, and by the same re-agents.

4. These phenomena are exactly similar to those exhibited by lapis lazuli subjected to the same operations.

5. We may therefore form at pleasure the blue colouring principle of lapis lazuli, the difference in the natural production necessarily resulting from the slow combination of this principle with the earths and sulphat of lime alone excepted.

6. In the last place, the blue sulfure of iron is the real and sole colouring principle of all the varieties of the lapis lazuli, and probably of that mineral also known under the name of the blue stone of Vorau.

**VI. Account of certain Phenomena observed in the Air-Vault of the Furnaces of the Devon Iron-Works\***; together with some practical Remarks on the Management of Blast-Furnaces. By Mr. ROEBUCK, in a Letter to Sir JAMES HALL, Bart. Communicated by Sir JAMES HALL†.

I HAVE examined my memorandums concerning the observations I made on the condensed air in the air-vault of the Devon iron-works near Alloa; and, according to your request, I now transmit you an account of them; and also of an experiment I made, when a partner and manager of these works, in order to increase the produce of blast-furnaces.

The two blast-furnaces at Devon are of large dimensions, each being 44 feet high, and about 13 feet wide in the boshes, or widest part, and are formed on a steep bank, by two pits sunk in a very solid stratum of coarse-grained freestone.

These pits were afterwards shaped and lined, in the usual manner of blast-furnaces, with common bricks and fire-bricks; and the hearth was laid with large blocks of the stone that had been dug out, and which serve the purpose of fire-stones. At the back of the two furnaces, next the bank, the air-vault is excavated, and formed by a mine drove in the solid rock, distant from the furnaces about 16 feet. The

\* These iron-works are on the banks of the river Devon, which runs into the Frith of Forth near Alloa. They are three miles from Alloa, and eight from Stirling.

† From *Transactions of the Royal Society of Edinburgh*, Vol. V. part 1. bottom

bottom of the air-vault is only about four feet higher than the level of the bottom of the furnaces. This vault has an aperture at one end to receive the air from the blowing machine, and has two at the opposite end, one of which receives the eduction-pipe, and the other is a door to give admittance occasionally into the vault. As the rock is extremely close and solid, the vault is dry, except that a little water ouzes very gently from the side next the bank in small drops, and does not appear to exceed an English pint in 24 hours.

These furnaces are provided with air, or blast, as it is termed, by the means of a fire-engine of the old, or Newcomen's construction. The diameter of the steam cylinder is  $48\frac{1}{2}$  inches; and the square area of its piston being about  $1866\frac{1}{2}$  square inches, the power of this sort of engine cannot be rated at more than 7 lb. to the square inch, amounting in all to about 13062 lb. This power was employed to work an air-pump, or blowing cylinder, of 78 inches diameter, and about 7 feet long. The number of square inches on the piston of the air-pump is 4778, and therefore this area, being multiplied by  $2\frac{1}{2}$ , will produce 13139; being a resistance that nearly balances the above-rated power, and shows that the air, which was expelled from the air-pump, could not be condensed more in the ordinary way of working than with a compressing power of about  $2\frac{1}{2}$  lb. on each square inch. As the engine was not regulated, at first, to make a longer stroke than about 4 feet 8 inches, only one furnace being used, the quantity of air expelled at each stroke of the machine was about 155 cubic feet, which it discharged through a valve into the air-vault about 16 times in a minute. When two furnaces afterwards were blown, the engine was regulated to work much quicker, and with a longer stroke. The air-vault is 72 feet long, 14 feet wide, and 13 feet high; and contains upwards of 13,000 cubic feet, or above 80 times the contents of the air-pump. The top, sides, and bottom of this vault, where the least fissure could be discovered in the beds of the rock, were carefully caulked with oakum, and afterwards plastered, and then covered with pitch and paper. The intention of blowing into the

the vault is to equalise the blast, or render it uniform, which it effects more completely than any machinery ever yet contrived for the same purpose. The air is conducted from the vault by the eduction-pipe, of 16 inches diameter, into an iron box or wind-chest, and from this it goes off to each furnace in two smaller pipes that terminate in nozzles, or blow-pipes, of only  $2\frac{1}{2}$  to  $\frac{3}{4}$  inch diameter at the tweer of the furnace.

When the furnace was put in blast, after having been filled with cokes, and gently heated for more than six weeks, the keepers allowed it to have but little blast at first, giving it a small blow-pipe of about  $2\frac{1}{4}$  inch diameter, and likewise letting off a very considerable quantity of air, at the escape, or safety-valve, on the top of the iron wind-chest; as it is a received, though erroneous opinion among them, that the blast must be let on very gradually for several months. From the construction of this valve it was impossible to ascertain the exact proportion of the blast they thus parted with, but I believe it was very considerable. The consequence was, that the furnace, after it had been in blast for several days, never seemed to arrive at its proper degree of heat, but was always black and cold about the tweer in the hearth, and appeared in danger of choaking, or gobbing, as it is termed.

After various experiments, tried in vain, by the keepers and the company's engineer, and others, (indeed they tried every thing, except giving the furnace a greater quantity of air, which, as I afterwards ascertained, was all that it wanted,) they concluded that the air-vault was the cause of the whole mischief; and, to confirm their opinion, they said they had now discovered that water was, in considerable quantities, driven out of the air-vault through the blow-pipe, which cooled the furnace; and they insisted, that the power of the engine was such as to force water out of the solid rock; so that this method of equalising the blast never would succeed. The other managing partner was so much alarmed by these representations, that he began to consult with the engineer, and others, about finding a substitute for the air-vault at any expence.

As the plan of the blowing apparatus had been adopted at  
my

my recommendation, and was now so loudly condemned on account of the water, I had other motives, than mere interest, for trying to become better acquainted with the phenomena attending it. I accordingly determined to go into the air-vault, and to remain enclosed in the condensed air while the engine was blowing the furnace. It is an experiment that perhaps never was made before, as there never existed such an opportunity. I could not persuade the engineer, or any other of the operative people about the work, to be my companions, as they imagined that there was much danger in the experiment. Mr. Neil Ryrie, however, one of the clerks of the Devon company, had sufficient confidence in my representations to venture himself along with me.

The machine had been stopped about two hours previous to our entering the vault, and we found a dampness and mistiness in it, which disappeared soon after the door was shut fast upon us, and the engine began to work in its usual manner. After four or five strokes of the engine, we both experienced a singular sensation in our ears, as if they were stopped by the fingers, which continued as long as we remained in the condensed air. Our breathing was not in the least affected. I had no thermometer with me, but the temperature of the air felt to us the same as that without the vault. Sound was much magnified, as we perceived, when we talked to each other, or struck any thing; particularly the noise of the air escaping at the blow-pipe, or waste valve, was very loud, and seemed to return back to us. There was no appearance of wind to disturb the flame of our candles; on the contrary, I was surprised to find, that when we put one of them into the education-pipe, which conveys the wind from the vault to the furnaces, it was not blown out. There was not the smallest appearance of any drops of water issuing out of this pipe. The ouzing and dropping of water from the side of the rock next the bank, seemed the same as before the condensation was made in the vault. In short, every thing appeared, in other respects, the same as when we were in the common atmosphere. Having remained about an hour in the condensed air, and satisfied ourselves that no water, during that time, that we could in the least discover, was agitated

agitated and forced out of the rock and vault by the power of the blast, as was imagined and insisted on, we gave the signal to stop the engine. As soon as it ceased to work, and the condensation abated, and before the door of the vault was unscrewed, *the whole vault, in a few seconds, became filled with a thick vapour, so that we could hardly see the candles at four or five yards distance.* The door being now opened, the work-people, anxious to know our situation, and what had occurred, came into the vault, and prevented any further observations. I now endeavoured to account for this curious appearance of the water, which only showed itself occasionally, in very small quantities, at the tweer, and at a hole I ordered to be made in the bottom of the wind-chest to collect it more accurately; for it never was observed, but either when the engine, after working slowly, was made to work quicker, or, after having been stopped for a few minutes, was set to work again.

I considered the vapour which we had discovered in the vault to arise from the moisture of the side of the rock next the furnace, which being expelled by the great heat of the furnace, and converted into vapour, was able to force its way through the pores of the rock into the vault; but that being in a manner confined within the rock, by the pressure of the condensed air, it found itself at liberty to come into the vault only when the condensation abated considerably, or was totally removed by the going slow, or stopping of the engine. It also occurred to me, that the air, in a state of condensation, might possibly be capable of holding a greater quantity of water in solution, which might precipitate suddenly into vapour or mist when the condensation abated. I imagined, therefore, that the very small quantities of water we at times discovered, proceeded from nothing else but this vapour in its passage to the furnace along with the blast, being condensed into water, by the coolness of the education-pipe and iron wind-chest. The quantity of water did not appear to amount to a gallon in twenty-four hours.

A few days after I had made this experiment, the water ceased entirely to make its appearance, either at the tweer or at the hole in the wind-chest; but the furnace did not come into

into heat for a long while after, and indeed not till the keepers let much more air into it by a larger blow-pipe, and allowed less air to escape at the safety valve. It is probable that the rock was now become perfectly dry by the continued heat of the furnace.

My experiment had the good effect to remove all the prejudices against the plan I had adopted of blowing the furnaces, and likewise prevented the other partner from laying out a large sum of money, by stopping the works, and altering the blowing machinery. Indeed, it has since been admitted, by all who have seen it at work, to be the most simple and effective method of equalising the blast of any yet put in practice.

This experiment led me, some time afterwards, to apply a wind-gauge that I contrived, to ascertain precisely the state of the condensation of the air thrown into the furnaces. I found that a column of quicksilver was raised five inches; and sometimes, though seldom, six inches; and, in the interval of the return of the engine to receive air into the air-pump, it fell only half of an inch. At this time only one furnace was worked. But when two furnaces were in blast, the engine only raised the mercurial gauge about four inches; because the Devon company, for certain reasons, did not, while I continued a partner, think proper to allow the blowing machinery to be completed, by the putting to work their second boiler of twenty feet diameter for the fire-engine, according to my original design, which, by adjusting the machinery, would have enabled us to blow two furnaces, with two boilers, with as much effect, in proportion, as one furnace with one boiler. This instrument had the advantage of enabling the work-people to discover the real power of their blast, and know the exact condition of the air-valves, and the gearing of the blowing piston; for, if these were not tight, and in order, (although the engine might, to appearance, be doing well, by making the same number of discharges of the air-pump as usual *per minute*,) yet the wind-gauge would not rise so high, and would show that there was an imperfection somewhere, by reason of a quantity of air escaping at the valves, or piston, that could not so easily otherwise be known.

This contrivance was considered as of much use, and was afterwards always quoted in the company's journal books, to show the actual state of the blowing machine, in comparing the daily produce of the furnaces.

I hope you will not think me tedious, when I explain to you another experiment, which appears to me to be of considerable importance to all manufacturers of cast iron.

I had reason to conjecture, from my own observations on the effects of blowing machinery on blast-furnaces, as well as from the knowledge I had acquired from my father, Dr. Roebuck, and from my communications with other experienced iron masters, that a great part of the power of such machinery was misapplied in general practice by throwing air into furnaces with much greater velocity than necessary; and that, if this velocity was, to a certain degree, diminished, the same power, by properly adjusting the blowing machinery, of whatever nature, would be capable of throwing into the furnace a proportionally greater quantity of air. For, "*Since the quantities of any fluid, issuing through the same aperture, are as the square roots of the pressure;*" it follows, that it would require *four* times the pressure, or power, to expel *double* the quantity of air, through the same aperture, in the same time: but if the area of the aperture was doubled, then the quantity of air expelled by the same power, and in the same time, would be increased in the ratio of the square root of 2 to 1, though its velocity would be diminished exactly in the same proportion. Again: I considered that the quantity and intensity of heat produced in blast-furnaces, and consequently its effects in increasing the produce, might be only in proportion to the quantity of air decomposed in the process of combustion, without regard to its greater velocity; that is to say, whether or not the same quantity of air was forced, in the same time, into the furnace through a small pipe, or through one of larger dimensions; for, in attending to the process of a common air-furnace for remelting of iron, where there is a very large quantity of air admitted through the large areas between the bars, it is well known that a much greater intensity of heat is produced than takes place in a blast-furnace.

nace, and yet the air does not enter into the fire through the bars with increased density or great velocity. I therefore thought it probable, that increasing the *quantity* of air, thrown into the blast-furnace, in a considerable degree, although the *velocity* or *density* might be much less, would have the effect of increasing its heat, and operations, and produce. And as, from the principles above stated, with regard to the machinery, I saw I could greatly increase the quantity of air thrown into the furnace, by enlarging the diameter of the blow-pipe, and regulating the engine accordingly, without being obliged to employ more power, I was anxious to make this experiment.

A system of management, of which I did by no means approve, was adopted by the other partners of the Devon company soon after the works were begun to be erected; and, in the prosecution of it, they ordered their second furnace to be put in blast, without permitting those measures to be taken that were necessary to provide and maintain a sufficient stock of materials; and also, without allowing their blowing machine to be completed, according to the original design, by the addition of its second boiler. As might have been expected, a trial of several months to carry on two furnaces, with only half the power of steam that was necessary, and an inadequate stock of materials, proving unsuccessful, the company, as a remedy, instead of making up the above deficiencies, ordered one of the furnaces to be blown out, and stopped altogether. This improper measure, however, afforded me the opportunity of immediately putting in practice the plan I have mentioned.

When one of the furnaces was stopped, the other continued to be blown by a blow-pipe of  $2\frac{1}{2}$  inches diameter, and the produce of the furnace, for several weeks thereafter, was not 20 tons of iron *per week* at an average. The engine at this time was making about 16 strokes a minute, with a stroke of the air-pump, about 4 feet 8 inches long; but when I altered the diameter of the blow-pipe, first to 3, and immediately after to  $3\frac{1}{2}$  inches diameter, and regulated the working gears of the engine, so as to make a stroke of 5 feet 2 inches long, and about 19 strokes in a minute, on an

average, the produce was immediately increased. It continued to be, on an average of nine months immediately after this improvement, at the rate of 33 tons of iron *per week*, of as good quality as formerly; for during this period, from the 21st of November 1795, to July 30, 1796, this one furnace yielded 1188 tons of iron. No more coals were consumed in working the blast-engine, or other expences about the blowing machine incurred, and therefore no more power was employed to produce this great effect. It is also of much importance to remark, that the consumption of materials, from which this large produce was obtained, was by no means so great as formerly. The furnace required very considerably *less fuel, less ironstone, and less limestone*, than were employed to produce the same quantity of iron by the former method of blowing; and according to the statements made out by the company's orders, as great a change was effected in the economical part of the business.

From the success of this experiment, so well authenticated, and continued for several months, I am led to be of opinion, that all blast-furnaces, by a proper adjustment of such machinery as they are provided with, might greatly and advantageously increase their produce, by assuming this as a principle, *viz.* “*That with the given power it is rather by a great quantity of air thrown into the furnace, with a moderate velocity, than by a less quantity thrown in with a greater velocity, that the greatest benefit is derived, in the smelting of ironstones, in order to produce pig-iron.*” However, it is by experiment alone, perhaps, that we can be enabled to find out the exact relations of power, velocity, and quantity of air requisite to produce a maximum of effect\*.

But

\* If  $Q$  be the quantity of a fluid, issuing in a given time through an aperture of the diameter  $D$ ,  $V$  its velocity, and  $P$  the power by which it is forced through the aperture; then the area of that aperture being as  $D^2$ , the quantity of the fluid issuing in the given time will be as  $VD^2$ , or  $VD^2 = Q$ .

Again: this quantity multiplied into its velocity, will be as the momentum of the fluid expelled, or as the power by which it is expelled, that is,  $V^2 D^2 = P$ , or  $VD = \sqrt{P}$ .

Here, therefore, if  $D$  is given,  $V$  is as  $\sqrt{P}$ , as Mr. Roebeck affirms.

*Alio,*

But an unfortunate disagreement among the partners of the Devon company put it out of my power to make further progress in this matter, by laying me under the necessity, two years ago, of withdrawing myself entirely from the concern.

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In order to illustrate what is said above, a ground plan of the air-vault and furnaces of the Devon iron-works is given in Plate X. of which the explanation follows :

*Explanation of Fig. 1. Plate X.*

A the air-vault, formed by a mine drove in the solid rock of coarse grained freestone. B the blowing cylinder. C the pipe that conveys the air from the blowing cylinder to the air-vault. D, the exhalation-pipe, that carries the air from the air-vault to the iron wind-chest. E, the iron wind-chest, (about  $2\frac{1}{2}$  feet cube,) in which is inserted a wind-gauge, represented in Fig. 3. F F, the two blow-pipes for each furnace, which terminate in apertures of  $3\frac{1}{4}$  inches diameter at the tweers of the furnaces. G G, the two blast-furnaces, placed in two pits sunk in the solid rock. H H, the timps of the furnaces, from whence the cast iron is run off into the casting room LL. O, the door to give occasional admittance into the air-vault. M, the excavation, in which is placed the blowing machine.

*Explanation of Fig. 2.*

A, the end of the wind-gauge, (about 12 inches long,) which is open to the atmosphere, being half filled with quicksilver. B, the end that is inserted in the iron wind-chest, and exposed to the pressure of the condensed air of the air-vault.

Also, because  $V = \frac{Q}{D^2}$ , and also  $V = \frac{\sqrt{P}}{D}$ ,  $Q = D\sqrt{P}$ , so that, while

P remains the same, Q will increase as D increases, and V will diminish in the same ratio.

The problem, therefore, of throwing the greatest quantity of air into the furnace, with a given power, strictly speaking, has no *maximum*, but the largest aperture of which the engine can admit must be the best. It is probable, however, that there is a certain velocity with which the air ought to enter into the furnace ; this will produce a limitation of the problem, which, as Mr. Roebuck suggests, is not likely to be discovered but by experiment. J. P.

VII. *Communication from Dr. BLACKBURN respecting  
Caloric, Light, and Colours.*

"SIR,

Spring Garden, May. 15, 1800.

"**I**T is now more than twelve months since I announced my intention of publishing some remarks concerning the use of the word *heat*, and the constitution of light. My avocations have not allowed me to fulfil my promise; and being still uncertain when I may be able to finish for publication, I shall be much obliged to you to insert in your respectable Journal the following brief results of my investigation concerning light, which I conceive to be of more importance than those concerning heat, which chiefly relate to verbal criticism. The proofs and reasoning on which these results depend, will, I hope, be soon submitted to the public.

"I am, &c.

"*Mr. Tilloch.*

WILLIAM BLACKBURNE."

**1st**, Light is a compound resulting from a peculiar combination of caloric and oxygen.

**2dly**, In all those phenomena which have given occasion to the idea that light is identical with, or a modification of, caloric, the manifestation of the latter principle is to be referred to the disunion of the constituting principles of light. The caloric, therefore, which so frequently results from the application of light to various substances, issues from the decomposition of light in various degrees.

**3dly**, The phenomena of colours are to be ascribed to the different qualities of light, as containing caloric and oxygen in different proportions. The different proportions manifest themselves in the circumstances both of the decomposition and the formation of variously coloured light.

**4thly**, The separation of light by the prism is to be regarded as a chemical decomposition, not a physical or mechanical division of light.

**5thly**, The changes which take place in the colours of different substances, as of plants in the process of vegetation, of metals in that of oxydation, are owing to correspondent

spondent changes which these substances undergo in their chemical action upon light.

6thly, The evanescence, or, as it is frequently termed, the absorption, of light, is to be referred to the complete resolution of this compound into its constituent parts.

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VIII. *Memoir on Azot, and on the Question, Whether it be a simple or a compound Body. By CHRISTOPHER GIRTANNER, M. D., of Gottingen.\**

**T**HE most celebrated chemists have long known the important part which azot performs in all the operations of nature. Lavoisier, Fourcroy, Berthollet, Van Mons, Guyton, Chaptal, Vauquelin, Priestley, Van Marum, Goettling, Wiegleb, Von Hauch, Paets, Van Troostwyk, Deiman, and several others, have endeavoured, with more or less success, to study its nature; and it is to their labours united that we are indebted for a knowledge of its singular properties, which are very different from those of the other aëriform fluids with whose bases we are acquainted.

But it is in organised bodies that this singular principle seems to perform the most distinguished part. In the researches I have made for twelve years, respecting the mechanism of life in animals and plants, I always found myself stopped by this too little known principle. In my experiments I saw it appear and disappear, without being able to fix it, or to explain in what manner it had introduced itself into the body from which I extracted it. I began, therefore, to suspect that azot was not a simple body, but a compound. I formed several conjectures, which my experiments proved to be false; and, despairing of success, I had entirely given up pursuing this subject, when the dispute which arose respecting the azotic gas drawn from the steam of water, induced me to turn my attention to it once more. This dispute is not yet terminated, notwithstanding all that has been said for and against the conversion of steam into gas by

\* From the *Annales de Chimie*, No. 100. This is the memoir announced in the preceding number of the Philosophical Magazine, p. 216.

Goëtting, Wieglob, Von Hauch, Westrumb, Achard, Wurzer, Juch, Van Mons, Paets, Van Troostwyk, and Deiman. It appears to me that this famous dispute has a great resemblance to many others mentioned in the annals of our science, and by which the most important points of the theory of chemistry have been fixed. Such was the dispute on the existence or non-existence of the carbonic acid in chalk, which occupied all the chemists of Europe for several years; and such was that respecting the existence or non-existence of oxygen in the red oxyd of mercury: a dispute in which I myself was engaged, and abused by the German chemists, and particularly Gren, who was exceedingly apt to become warm \*.

Wieglob, Goëtting, and Von Crell, assert,

1. That the steam of water, in passing through ignited tubes, is converted into azotic gas.
2. That this change always takes place, and under all circumstances, provided the steam of the water is brought into contact with the ignited bodies.
3. That water is changed into azotic gas by combining itself with caloric.
4. That water is the ponderable base of azotic gas and of all the other gases.
5. That consequently the theory of Lavoisier is false.

The Dutch chemists, as well as Von Hauch, Juch, Van Mons, &c. maintain,

1. That the steam of water, in passing through ignited tubes, is not converted into azotic gas in any case whatever.
2. That the azotic gas obtained, has not been a production of the water, but has arisen from a part of the atmospheric air which passed through the tubes.
3. That consequently the theory of Lavoisier remains unshaken; and that the theory of phlogiston, or that of water, being the base of all the gases, is erroneous.

Being much interested in this dispute, I followed its progress with great attention; but I was sorry to see party

\* All the opinions maintained by Gren were erroneous; but he had the merit of writing his *Systematisches Handbuch*, which is an excellent compilation. Gren was a good compiler, but a bad reasoner.

spirit introduced into it, and that it was carried on with asperity on both sides; that the contending parties disputed not for the discovery of truth, but for victory; and that they were previously determined to discover nothing but what their particular theory required. This conduct prevented them from seeing the object under its real appearance: experiments were multiplied; each party denied those of the opposite party; results entirely different were found, and instead of approaching, they receded still further from each other. The only thing which interested me in this dispute was truth. I am firmly persuaded that the system of Lavoisier is agreeable to nature. Having heard of an experiment which I was told overthrown this system entirely, I immediately said: Let us repeat and examine it; if the system be false, we ought to abandon it as soon as possible, and not to wait till it abandon us. Let us not be attached to systems, but to truth; and when Nature speaks, let us listen to her voice in preference to that of a Stahl or a Lavoisier, a Descartes or a Newton. Whatever may be the result of our experiments, we shall profit by them: as we run the risque of losing nothing but error, let us hasten to subject ourselves to that loss.

Such was the manner in which I reasoned. I had learned from the history of chemistry, that in all disputes in which two parties obtained contrary results from similar experiments there was a mistake in the mode of expression, and that both at bottom were in the right; and I doubted whether this might not be the case in regard to the dispute in question. I proposed, therefore, to resolve the following points:

1. Is the steam of boiling water converted into azotic gas by passing through ignited tubes?
2. Under what circumstances does this change take place?
3. What is the rationale of this production of azotic gas?
4. Are these experiments contrary, or not, to the system of Lavoisier?

I will freely confess, before I enter on this discussion, that the manner in which the production of azotic gas had been explained, by making it pass from the external air through

the tubes, did not appear to me altogether satisfactory. I had, indeed, formerly adopted this explanation \*; but I soon abandoned an opinion so contrary to every thing that we know of caloric. I am really sorry to see an opinion so improbable defended by chemists of the first rank; but the history of chemistry affords many instances of the like kind. Before the immortal Lavoisier had proscribed phlogiston, the Stahlians extricated themselves from their embarrassment in a manner absolutely similar. They put oxyd of mercury in a crucible, shut the crucible in the closest manner possible, and exposed it to a strong heat. On opening it after it had cooled, the mercury was found fluid. But as such a reduction, according to the doctrine of Stahl, could not take place without the intervention of phlogiston, the Stahlians were asked to explain this phenomenon so contrary to their doctrine. Their answer was, that the phlogiston had passed through the crucible to join itself to the mercury. Even Bergmann and Scheele were satisfied with this absurd explanation †; which proves that the spirit of system misleads the ablest men, and renders them ridiculous in the eyes of posterity, more enlightened, and less slaves to prejudice. I shall show that azot does not pass through the sides of tubes, and that phlogiston does not pass through crucibles. The experiments which Priestley made to prove that the air passes through earthen retorts, does not prove what he pretended to prove. He saw the retorts smoke on the outside, but the water, as he imagines, did not pass through: the exterior part of the earthen retort only attracted the water of the atmosphere.

As I propose, in a particular work on azot, to give a detail of the numerous experiments I have made to ascertain its nature, I shall confine myself at present to a general view of them, as well as of the results which I think myself authorised to deduce from them. I think, then, that I may safely assert, that azotic gas is obtained:

1. When water is boiled in an earthen retort unglazed in

\* *Anfangsgrunde der antiphlogistischen chemie*, second edition, p. 89, 90.

† *Scheele von luft und feuer*, edition of Leonhardi, p. 42.

the inside, and when the steam is made to pass through a tube of glass or any other substance.

2. When water is boiled in a glass retort which contains argil or alumine, and the steam is made to pass through a tube of glass or of any other substance,

3. When common water is boiled in a glass retort, and the steam is made to pass through an earthen tube.

4. When common water is boiled in a glass retort, and the steam is made to pass through a glass tube which contains argil or alumine.

5. When an earthen tube, filled with water, is inclosed in a larger one of glass, with sand between them; and the tube of glass in another of iron, with sand between them, in the like manner, and the whole is exposed to the fire \*.

6. When water is boiled in a glass retort containing lime, and the steam of it is made to pass through a tube of glass or of any other substance.

7. When water is boiled in a glass retort containing pounded quartz or filex, and the steam is made to pass through a tube of glass or of any other substance.

8. The first experiment will equally succeed when the earthen retort is covered on the *outside* with a metallic glazing.

9. The third experiment will also succeed when the earthen tube is covered on the *outside* with a metallic glazing.

10. The fourth experiment will succeed, when, instead of argil, the tube is filled with lime or pounded quartz.

Only steam of water, but no azotic gas, is obtained :

1. When water is boiled in a glass retort, and the vapour is made to pass through tubes of glass or porcelain.

2. When water is boiled in an earthen retort covered on the inside with a metallic glazing, and the steam is made to pass through tubes of glass or porcelain.

3. When water is boiled in a glass retort filled with pounded glass, and the steam is made to pass through tubes of glass or porcelain,

\* This is one of Priestley's experiments, which I have not repeated. See his Experiments and Observations on different Kinds of Air, Birmingham 1790, Vol. II. p. 418.

*General Remarks.*

To obtain azotic gas in the greatest quantity, the water must be evaporated very slowly, and over a very gentle fire; and care must be taken not to increase the fire too much.

In every experiment of this kind, without exception, it may be observed, that when the last drop of water is evaporating the azotic gas ceases to be produced, though the fire be continued.

*Results of the Experiments.*

Such are the facts and plain statement of the experiments, independent of all system, of all explanation, and of all theory. It thence results:

1. That Messrs. Wieglob and Goettling were right in saying that water was converted into azotic gas by the action of fire.
2. That they were wrong in maintaining that this change always takes place, and under all circumstances, when the steam of the water is brought into contact with bodies brought to ignition in the fire.
3. That Mr. Wieglob has not proved what he asserts, *viz.* that the conversion of water into gas is owing to a mere addition of caloric, and that water forms the base of all the gases.
4. That the Dutch chemists were wrong in advancing that the conversion of water into azotic gas never took place in any case whatever; and that the gas obtained arose from atmospheric air which had passed through the retorts and the tubes.
5. That there are certain circumstances under which water is converted into azotic gas, and others where it is not; and that it is easy to reconcile the opposite parties.

The change of water into azotic gas by the action of caloric and of earths being ascertained, the question was, to find a solution of this problem. The manner in which I explain it is as follows:—I have observed, as well as Ingenhouz, Von Humboldt, and Van Mons, that moist earths are endowed with the property of absorbing the oxygen of the atmosphere at the common temperature. Besides, I have observed a circumstance, not mentioned by Von Humboldt,

that they absorb oxygen in less time, and in greater quantity, when they are heated. I found, by other experiments, that earths take the same oxygen from the water; but that, for this purpose, a temperature higher than that of the atmosphere is required. Argil, argillaceous earth, or alumine, is that which takes up oxygen with the greatest avidity, and at a temperature far below that of boiling water; lime requires a higher temperature, and does not charge itself so much with oxygen; filex, before it absorbs oxygen, must be brought to a state of ignition in the fire, but afterwards it takes it up very rapidly. Baked argil unites itself also with oxygen, but it requires a higher temperature. Glazed argil does not absorb oxygen, the glazing being made of metallic glass, which has no action on oxygen.

Having made these observations, I did not find it difficult to explain the phenomena of the conversion of water into azotic gas. Recollecting the hypothesis which M. Mayer had ventured to start, a few years ago, on the nature of azotic gas, by supposing that it was a compound of oxygen and hydrogen, water converted into a gas\*, I conceived a similar idea respecting it. As M. Mayer gave his hypothesis merely as an idea thrown out at hazard, and as he supported it with no chemical experiment whatever, I proposed to supply what he had left undone. Admitting this hypothesis, and reflecting on the singular property which earths have of absorbing the oxygen of water, I explained, without difficulty, the experiments above mentioned. They are the result of a double affinity. The oxygen of the water unites itself in part to the earth, which is converted into an earthy oxyd; the remainder of the oxygen in union with the hydrogen combines with the caloric, and forms azotic gas; consequently, *azot is water deprived of a part of its oxygen.*

This assertion is supported by various experiments: but I shall confine myself to a few only, and shall reserve the rest to be mentioned in a second memoir, after I have repeated them.

1. Provide porcelain tubes, and try them by transmitting through them the steam of boiling water, which will pass in

\* *Gren's Journal der Physik*, Vol. V. p. 382.

vapour without the least particle of gas except the air contained in the retort. After you have ascertained in this manner that the water is not changed into gas in these tubes, to prevent the objections of those who imagine that the external air passes through the tubes, fill one of them with filings of tin and put it into the fire, which you must take care to keep up. Then make the steam of water to pass through it. In the pneumatic apparatus you will obtain azotic gas mixed with oxygen gas. The tin is changed into an oxyd. This experiment, which was made by M. Von Hauch, may be easily explained from my principles. The tin takes from the water only a part of the oxygen it contains; the rest remains in union with the hydrogen, and forms azot.

2. By transmitting the steam of water over lead, in the same manner as in the preceding experiment, you will obtain, according to M. Von Hauch, the same result. At the commencement of the operation the oxyd of the lead passes under the bell with the gas and the steam of the water, and the metal then appears under the form of a very fine powder. The azotic gas obtained is in proportion to the oxygen gas almost as 64 to 36.

3. By transmitting, in the same manner, the steam of water through a tube filled with antimony, you obtain a mixture of azotic gas and oxygen gas. There will be 89 parts of the former, and 11 of the latter.

4. A porcelain tube was filled with black oxyd of manganese, and the tube exposed to a very strong heat for more than two hours, until the oxyd had entirely ceased to furnish oxygen gas. The steam of water was then made to pass over this oxyd deprived of the greater part of its oxygen. At first, oxygen gas pretty pure was obtained, and then azotic gas. This experiment of M. Von Hauch is very instructive. The manganese evidently absorbed, first the hydrogen, and then a part of the oxygen of the water.

5. The steam of water was made to pass through the same tube, filled with the same manganese which had served for the fourth experiment. Azotic gas was obtained; and the fire being continued for three hours, the disengagement of the azotic gas continued as long as the steam of the water

was made to pass. When no more steam was transmitted, the disengagement of the azot ceased; but it recommenced as soon as the water was again boiled, and new steam began to pass over the manganese. This experiment was repeated six days successively, each day for three hours, and always with the same success. When the operation was ended, the manganese was found cemented to the porcelain tube in such a manner that it could not be separated.

6. Dr. Pearson analysing water by an electric spark, always obtained azotic gas, besides the two gases of which water is composed.

7. The same gentleman burning, in a tube hermetically sealed, a mixture of oxygen and hydrogen gas by means of an electric spark, obtained water and azotic gas.

8. Dr. Priestley observed, that oxygen gas which had remained in contact for some time with the purest distilled water was in part changed into azotic gas. I have proved this observation, and I found 0.1 of azotic gas in the oxygen gas.

9. A mixture of hydrogen gas and nitrous gas, which remains for some time in contact with water, no longer burns, and is found changed into atmospheric air; which I explain by supposing that the hydrogen combines itself with a part of the oxygen of the nitrous gas, or of the water, and is converted into azotic gas. This experiment, which was made by Mr. Link, with me did not succeed.

10. Dr. Priestley found that hydrogen gas, which he had kept for a long time in contact with water, was entirely changed into azotic gas\*. This experiment does not always succeed. It succeeded four times with Priestley. It is, no doubt, necessary that the water should contain oxygen.

11. In burning a mixture of eleven cubic inches of hydrogen gas and one inch of oxygen gas, azotic gas is obtained. This experiment was made by M. Yelin, but with me did not succeed.

12. When the steam of water is made to pass through a gun-barrel which has been before employed several times for the same kind of experiments, and has been entirely oxydated

\* See Priestley's work before quoted, Vol. I. p. 230.

in the inside, no hydrogen gas is obtained, but azotie gas; as the iron is no longer able to take up any of the oxygen presented to it by the water. This is an experiment of M. Yelin, and was confirmed to me by M. Mayer.

13. An experiment made by Mr. Lampadius appears to me to prove, in a very satisfactory manner, the presence of oxygen in azotic gas. He fused arsenic in the purest azotic gas prepared by the combustion of phosphorus. The metal was sublimated, and at the end of the experiment it was found that it had been in part converted into oxyd of arsenic.

14. In the combustion of two gases to produce water, when the quantity of hydrogen is too great, nitric acid is obtained:

15. The following experiment, described by Scheele, appears to me a new proof that azot is nothing but oxyd of hydrogen. The following are the words of this celebrated chemist \*:—" I filled a bladder with air obtained from iron filings dissolved in the vitriolic acid, and inhaled this air. Having inspired it twenty times, I found myself obliged to desist. Having recovered a little, I exspired, as far as possible, all the air contained in my lungs, and then again respire the inflammable air. After ten inspirations I could inspire no more. The air, on being examined, was no longer inflammable; but, however, did not render turbid lime water. In a word, it was corrupted air, (azotic gas)." It may be perceived that in this experiment the pure hydrogen gas combined itself in the lungs with the oxygen gas, which remained after the preceding inspirations of atmospheric air, and formed there azotic gas.

16. For another experiment, which appears to me to corroborate my opinion respecting the nature of azotic gas, we are indebted to Mr. Henry, of Manchester. It was repeated by him several times, and always with the same success †. His explanation of this phenomenon, which is very different from mine, because he believes azot to be a simple body, may be found in the work below quoted. His experiment is as follows :—In a bent tube of glass he mixed, in a mer-

\* *Von luft und feuer*, p. 136.

† Scherer's *Allgemeines Journal der Chemie*, Vol. I. p. 97.

curial

curial pneumatic apparatus, 94·5 measures of carbonated hydrogen gas, and 107·5 measures of very pure oxygen gas (obtained from the oxygenated muriat of potash). This mixture, forming 202 measures, was reduced, by an electric explosion made to pass through it, to 128·5 measures, and then, by lime-water, to 54·0: a solution of the sulphat of potash diminished the remainder to 23 measures. In this experiment, therefore, 23 measures of azotic gas were produced by an electric explosion, the oxygen uniting itself to the hydrogen.

17. Of all the known bodies, zinc, if I am not mistaken, is that which unites easiest with oxygen; it takes it from almost all other bodies, and this renders it exceedingly proper for enabling us to discover the smallest quantities of oxygen. It was by means of zinc in particular that I was able to separate the oxygen of the muriatic acid from its base: I employed it also to make the latest analysis of ammonia. If filings of zinc be mixed in a retort with concentrated liquid ammonia, the retort being made to communicate with a pneumatic apparatus; and if it be kept in digestion for several days, taking care not to increase the fire too much, the ammonia will be decomposed. In the retort you will obtain oxyd of zinc, and under the pneumatic apparatus hydrogen gas in considerable quantity, mixed with a small portion of ammoniacal gas and azotic gas not decomposed. It is easy to prove that it is not the water with which the ammonia has been diluted that could furnish the hydrogen gas obtained, because the hydrogen is obtained in too large quantity, and the azot in too small, to leave any doubt in regard to the decomposition of the latter.

Such are the experiments from which we may, I think, conclude that azot is a compound of hydrogen and oxygen. In a second memoir I shall make known several other experiments no less decisive, but which require to be repeated before they can be submitted to the examination of the able and accurate chemists to whom this paper is addressed. Azot, then, if I am not mistaken, being a body compounded of hydrogen and oxygen, it thence follows, that the atmosphere is

not, as hitherto believed, a mixture of oxygen gas and azotic gas, but rather a mixture of oxygen gas and hydrogen, and, if I may be allowed the expression, water in the form of gas. When by chemical experiments, which very improperly have been called *eudiometric*, the oxygen is separated from the hydrogen, this separation never can be effected entirely or completely: a part of the oxygen remains united to the hydrogen, and forms that chemical combination which we call azot, and which we obtain by the above experiments. Oxygen, so indispensably necessary for supporting the life of organised beings, is, by its combination with hydrogen, converted into azot, which not only is unfit for maintaining life, but is a real poison, on account of the affinity it has for oxygen, and the avidity with which it takes it from organised bodies.

Oxygen has so great an affinity for hydrogen, when both are found mixed in the atmosphere, that it is very difficult to separate them entirely: for this reason, the analysis of azot has been attended with great trouble. When charcoal, sulphur, a taper, and metals, cease to burn in atmospheric air, and when animals expire in it, it still contains a pretty large portion of oxygen. Phosphorus burns in it exceedingly well, and for a very long time; and even when phosphorus ceases to burn there always remains a small quantity of oxygen united to the hydrogen; that is to say, there still remains azot. Atmospheric air, however, as I have several times observed, may be deprived of almost all its oxygen, and the analysis of it may be rendered almost complete, by heating phosphorus in it for some time. Phosphorated hydrogen gas will then be obtained by the conversion of a part of the azot into hydrogen.

It results from these experiments, that eudiometry, such as it exists at present, is founded on erroneous principles. The azot obtained by these experiments being always a product of the operation, and not having previously existed under the form of azot in the air subjected to examination, Von Humboldt, who is fond of drawing general conclusions from individual facts, seems to have been deceived when he asserts, that earths might be employed to determine the quantity of azot.

azot contained in atmospheric air. Earths do not indicate the azot contained in atmospheric air; they convert that air into azot.

Cultivated earth being in contact with the atmosphere absorbs its oxygen and forms azot. In the polar regions, and on the summits of the Alps, where the earth is always covered with snow, the atmospheric air contains a greater quantity of oxygen than in the southern countries or in the plains, as the snow prevents the air from coming in contact with the earth.

Since the constituent parts of azot are now known, we might write a new theory of the art of making saltpetre. The *Annales de Chimie*\* contain some very valuable observations on this subject; for example, the following:— “The earth taken up from deep subterraneous places well secured from the light, such as cellars, requires only to be exposed to the air a few days to produce abundance of saltpetre. It is worthy of observation, that such earth does not furnish an atom of nitrat when taken from the damp and obscure places where it was formed, and that it is only by the combination or combustion of the azot of the earth by the oxygen of the atmosphere that this salt is produced.” The explanation given of this interesting phenomenon in the same work †, is a proof how far we were from the truth before the nature of azot was better known.

As lime absorbs oxygen with avidity, we see the reason of the insalubrity of apartments the walls of which have been recently whitened.

The following bodies are combinations of hydrogen with oxygen in different proportions: azot, the gaseous oxyd of azot, nitrous gas, the nitrous acid, the nitric acid, the muriatic acid, the oxygenated muriatic acid, the nitro-muriatic acid, water, atmospheric air, ammonia. I hope to be able soon to prove that to this list we ought to add potash, soda, and sulphur. Phosphorus appears to me to be hydrogen in the purest slate with which we are acquainted with it; but this I am far from being able to prove. In regard to the

\* Vol. XX. p. 313.

† Page 314.

analysis of fixed alkalies, it has been effected completely: As I do not intend to enlarge on this subject in the present memoir, I shall only mention one of those experiments which are conclusive. When alkali is fused with filex for the purpose of making glass, you analyse the alkali. The hydrogen escapes under the form of a gas, and the oxygen combines itself with the filex, glass being nothing else but an oxyd of filex. Too much oxygen, however, must not enter into the composition, as it would render it less transparent: this is the reason why glass-makers add substances greedy of oxygen, as manganese.

Having communicated to M. Mayer the result of my experiments, by which I so evidently confirmed an idea thrown out by him at hazard, and of which he has the merit of being the author, this learned philosopher sent me a short memoir, of which the following is an extract:—"I am inclined to believe," says he, "with Mr. De Luc, that the evaporation of water, such as effected by nature on a large scale, is a real conversion of water into air. It is indeed true, that we have never yet been able in our laboratories to convert water into air by evaporation; but the reason of this is, that we are unacquainted with the part which both light and electricity perform in evaporation in general. It appears to me probable, however, that the ponderable parts of atmospheric air, that is to say, oxygen and azot, have no other source than from the water with which the surface of our globe is covered. The very small quantity of oxygen gas which vegetables exhale by the influence of the solar light, is far from being able to make good the enormous consumption of oxygen which daily takes place in our atmosphere so many different ways: but by supposing, according to this theory, that 100 grains of water are converted by the secret process of nature into 100 grains of atmospheric air, that is to say, into a chemical mixture of oxygen and hydrogen, we may find, by a very simple calculation, in what proportion the oxygen and hydrogen combine to form the azot which we find in the atmosphere. We must, however, keep in view, that what we call azot is not always of the same nature, and that there is considerable

considerable variation in the proportions of its constituent principles \*.

" I shall call the water W, the oxygen O, the hydrogen H, the ponderable part of atmospheric air L, and the ponderable part of azotic gas S,

$$\text{Then } 100 \text{ W} = 85 \text{ O} + 15 \text{ H.}$$

" But a cubic inch of atmospheric air is a mixture of  $\frac{1}{4}$  cubic inch of oxygen gas and  $\frac{3}{4}$  cubic inches of azotic gas; therefore,

$$1 \cdot L = \frac{1}{4} O + \frac{3}{4} S.$$

" One inch of atmospheric air weighs 0.46 grains, one of oxygen gas 0.51 grains, and one of azotic gas 0.44 grains; consequently,

$$0.46 L = \frac{0.51}{4} O + \frac{3}{4} 0.44 S.$$

$$1.84 L = 0.51 O + 1.32 S.$$

$$184 L = 51 O + 132 S.$$

$$100 L = 27.8 O + 72.2 S.$$

" Azotic gas being a compound of oxygen and hydrogen,

$$S = x O + y H; \text{ therefore,}$$

$$100 L = (27.8 + 72.2 x) O + 72.2 y H.$$

" But nature converts 100 grains of water into 100 grains of atmospheric air; consequently,

$$100 W = 100 L; \text{ then,}$$

$$27.8 + 72.2 x = 85$$

$$72.27 = 15$$

" Therefore  $x = 0.79$ , and  $y = 0.21$  nearly.

$$S = 0.79 O + 0.21 H, \text{ or } 100 S = 79 O + 21 H.$$

" That is to say, 100 grains of azotic gas are composed of 79 grains of oxygen and 21 grains of hydrogen."

Having applied this ingenious mode of calculation, employed by M. Mayer, to the other oxyds of hydrogen, I had the following result:

If N be the nitric acid, we know by experiment that

$$100 N = 79.5 O + 20.5 S.$$

\* This is a very important point, to which M. Mayer has directed our attention. It will be necessary to make a great number of very accurate experiments to determine the different degrees of the oxydation of hydrogen, and to distinguish the different gases hitherto comprehended under the general name of *azotic gas*.

Now,

Now, instead of S let us substitute its value found by the preceding calculation, and we shall have

$$100 \text{ N} = 79.5 \text{ O} + 20.5 (0.79 \text{ O} + 0.21 \text{ H}) = 95.7 \text{ O} + 4.3 \text{ H} \text{ nearly.}$$

100 Grains of nitric acid contain, therefore, nearly 96 grains of oxygen and 4 grains of hydrogen.

The same mode of calculation gave me also the following results :

$$100 \text{ Parts of ammonia} = 63.72 \text{ oxygen} + 36.28 \text{ hyd.}$$

$$100 \text{ Parts azot} = 79.0 \text{ oxygen} + 21.0 \text{ hydrogen.}$$

$$100 \text{ Parts of atmospheric air} = 84.67 \text{ oxyg.} + 15.33 \text{ hyd.}$$

$$100 \text{ Parts of water} = 85.66 \text{ oxygen} + 14.34 \text{ hydrogen.}$$

$$100 \text{ Parts of the gaseous oxyd of azot} = 86.77 \text{ oxygen} + 13.23 \text{ hydrogen.}$$

$$100 \text{ Parts of nitrous gas} = 93.28 \text{ oxygen} + 6.72 \text{ hyd.}$$

$$100 \text{ Parts of the nitrous acid} = 94.33 \text{ oxyg.} + 5.67 \text{ hyd.}$$

$$100 \text{ Parts of the nitric acid} = 95.70 \text{ oxyg.} + 4.30 \text{ hyd.}$$

May not oxygen and hydrogen be the two elements of which all bodies in nature are composed ? To me this seems not at all improbable. It seems probable, also, that the heavier a body, the more it contains oxygen in a concentrated state, and deprived of caloric ; and that, on the other hand, the more a body contains hydrogen, the lighter it ought to be. But these are merely hypotheses, which must be confirmed or refuted by future experiments.

It is seldom as simple bodies, but rather as compounds in different proportions, that the two constituent principles of azot enter into the combination of bodies. Carbon or the oxyd of the diamond is found in many bodies, and the diamond in none with which we are acquainted. We obtain carbon in our chemical decompositions, and not diamond. We do not even know the diamond or diamontic (adamantine) acid, though we know very well the carbonic acid. No chemist will think of saying that we exhale diamond in respiration, but carbon. The diamond, perhaps, is not even a simple body ; in all probability it contains still oxygen ; for all transparent bodies, if I am not mistaken, contain more or less of it. Thus, azot as well as carbon enters into several combinations as azot, as a double principle, which gives bodies very different

different properties from those they would have were they combined with the two simple principles of which azot is composed. Azot, as a constituent principle of bodies, is not hydrogen and oxygen, but azot; in the same manner as soap is not oil and alkali, but soap. Of this observation we ought never to lose sight.

In several experiments I have observed that sulphur often exhibits a yellow or yellowish orange colour. We shall seldom be deceived if we suspect the existence of sulphur in all bodies which exhibit that colour. Bodies which contain carbon are black, brown, or violet. Azot announces itself by a green colour: stunted plants, which vegetate sheltered from the air and light, are white, and contain very little azot: if exposed to these two agents for some days, they assume a green colour, and the proportion of azot in their composition is much more considerable. When nitrat of potash is fused in a glass retort, and the oxygen gas is disengaged from it, one may observe at the end of the operation, when the azot is formed, that is to say, when the oxygen has a greater affinity to the hydrogen than to the caloric, that the green colour appears, and the disengagement of oxygen gas ceases entirely.

But what requires the attention of all philosophers is, that when water is exposed to the sun the light decomposes it, and disengages the oxygen in a large quantity. The hydrogen then retains the last portions of the oxygen; azot is formed, and announces itself by its green colour; the water is more and more decomposed; more of the oxygen (which I have demonstrated to be the principle of life and irritability in organised nature) becomes fixed; and this azot, produced from water by means of the sun, is an organised body, the *conferva fontinalis*; a plant which lives, expands, and perpetuates its species. These are the boundaries at which the philosopher ought to stop; it is here that he ought to admire and respect the secrets of Nature, without knowing whether he will ever be allowed to penetrate the veil by which they are hid. What is certain, and what I have assured myself of by a great number of experiments, with which I have been occupied every summer for more than twelve years, is, that the influence of the solar light is absolutely necessary for this

conversion of water into a plant or *organised azot*. No degree of heat can supply its place; and this single experiment might be sufficient to convince every unprejudiced reasoner, that heat and light are two substances entirely different. I am surprised that this green matter of Priestley, this *fontinalis*, should not have been more attended to by chemists. It is the most wonderful substance existing; the most singular body in nature. Nothing can be more absurd than what has been advanced by Priestley. To reason as he does, is to reason like a child. This celebrated man, whose name will live as long as the sciences are cultivated, has made most important discoveries. I admire his sagacity, but I am sorry to see in all his works that he is rather an experimenter than a philosopher. While he displays to us with one hand the astonishing secrets of Nature, he keeps the other always ready to close our eyes, lest we should show a desire of penetrating further than he chooses us to extend our view. He has given us a striking instance of his unwillingness to allow us to see the wonders of Nature, except through his sacerdotal glass, in the dispute which he had with Dr. Ingenhouz respecting the green matter in question. Ingenhouz, an enlightened naturalist, having described a great number of experiments respecting this singular substance, which are worthy the attention of every thinking being, adds: "The water itself, or some substance in the water, is, in my opinion, converted into this kind of vegetation. It is a real transmutation, which may appear incomprehensible to the philosopher, but which, at bottom, is not more extraordinary than the change of grass and other vegetables into grease in the bodies of graminivorous animals, and the change of the aqueous juice of the olive into oil."

Water is changed into a plant: such is the fact. There Ingenhouz stops. He says, I have no comprehension of the cause. This is the language of a philosopher. Priestley, on the other hand, is scandalised at this language; and he asks Dr. Ingenhouz, if he is not ashamed to attempt to revive the long ago refuted doctrine of spontaneous generation\*. He speaks

\* Priestley says that the theory of spontaneous generation is a doctrine long

speaks to him almost in the same manner as the inquisitor to Galileo when he endeavoured to prove to that immortal man that the sun moved round the earth. Priestley then gives us his own theory on the production of organised azot. The seeds of this plant, he says, float every where; in the air, on the earth, on the sea, on the Alps, in the plains, under the poles and the equator, in summer and winter, and in all seasons, and are received into the water, where they germinate: but organised azot is produced in bottles well corked. Dr. Ingénouz has even proved, that by filling a bottle with well water, and inverting it in a basin filled with water, organised azot is formed in large quantities. Priestley, who could not maintain, without supposing an intelligence superior to the pretended seeds of this plant, that they had come through the water on purpose to settle in this bottle prepared for them, extricates himself from his difficulty by making them pass through the glass by imperceptible fissures\*. Such long ago refuted. The following are his own words: “*considering how long the doctrine of equivocal or spontaneous generation has been exploded.*” A philosopher ought never to make use of such an expression. There is no refuted opinion to which we may not recur, and again examine. Philosophy acknowledges no authority which can proscribe it from admitting, or forbid it to examine. There are many other opinions, long ago refuted, to which we ought still to recur; for example, that of the transmutation of metals. What chemist at present will dare to deny the possibility of it? The change of one metal into another ought to appear less difficult than the conversion of the sweetest body (sugar) into the sourlest (oxalic acid); than the change of the hardest body (the diamond) into the softest (carbonic acid gas); than the change of the most transparent (the diamond) into the most opaque (charcoal). In the 19th century the transmutation of metals will be generally known and practised. Every chemist, every artist will make gold; kitchen utensils will be of silver, and even gold, which will contribute more than any thing else to prolong life, poisoned at present by the oxyds of copper, lead, and iron, which we daily swallow with our food. There will then be no other riches than natural riches; the productions of the soil: artificial riches, such as gold, silver, and paper money, will vanish in the hands of those who have accumulated them. What a revolution in society! Every enlightened chemist, however, will agree with me, that this revolution is not only probable, but at no great distance.—*Note of the Author.*

\* Through some unperceived fracture, Vol. III. p. 294. The seeds of this plant insinuate themselves into vessels of water through the smallest apertures, p. 308.

is the method which mankind have always employed when they did not choose to see what was only too evident. It is thus that phlogiston has been made to pass through crucibles, and azot through tubes and retorts.

I shall here observe, that to make these experiments succeed, it is absolutely necessary that the water should contain gas in solution, either oxygen gas or carbonic acid gas. The more gas it contains, the sooner organised azot will be formed in it.

It is much to be wished that chemists would examine with attention what changes earths undergo by the oxygen which they absorb by decomposing the steam of water. I have no doubt that such an examination would lead to very important discoveries. These ideas I submit to the knowledge and criticism of the illustrious French chemists the editors of the *Annales de Chimie*, the fathers of the science; by them it was created. Before them, chemistry was only a shapeless mass of facts, ill arranged and still worse explained.

**IX. Method of detecting the Presence of Sulphur and Arsenic in Ore, and of accurately determining the Quantity.** By B. G. SAGE, Director of the first School of Mines.

**T**H E torrefaction or roasting of a mineral disengages and decomposes the arsenic and sulphur it contains: but the earth of the metal is calcined, and lays hold of a portion of the acid and the water; which increases its weight, so that no just estimate can be formed of the proportions of sulphur and arsenic which the mineral contains. Besides, these two substances burn simultaneously: torrefaction, therefore, is not sufficient to afford any precision.

The distillation of two parts of the vitriolic acid with one of the pulverised mineral, which contains sulphur and arsenic combined with metallic substances, furnishes the means of determining with precision the quantity of sulphur and arsenic they contain. There first passes over sulphureous acid, which arises from the decomposition of the *metallic part*\*, and of

the

\* The author here uses the term *metallifateur*, on which he has the following

the vitriolic acid; the sulphur is disengaged of a citrine colour, and the arsenic under the form of a white calx. The calcined metallic vitriol remains in the retort. By this process I obtained from sulphurous and arsenical cobalt ore,

White calx of arsenic	-	36
Citrine-coloured sulphur	-	15
		51

These substances served to mineralise the cobalt, to give it the property of efflorescing into vitriol of cobalt in a moist place. This salt is soluble in water; and in this it differs from the lilac-coloured arsenical efflorescence of cobalt. Having treated in the same manner ore of nickel\*, there passed over sulphurous acid, citrine-coloured sulphur, and white calx of arsenic: there remained in the retort green calx of nickel in part vitriolated. The sulphurous and arsenical ore of nickel which I employed had no matrix, and was covered with an efflorescence of a dirty green colour: its internal tissue was gray inclining to red. It produced per quintal,

Sulphur	-	3
Arsenic	-	22
Nickel	-	75

X. Experiments and Observations on Shell and Bone. By  
CHARLES HATCHETT, Esq. F.R.S.

[Concluded from Page 29.]

THE bones of fish, such as those of the salmon, mackerel, brill, and skate, afforded phosphat of lime; and the only difference was, that the bones of these fish appeared in general to contain more of the cartilaginous substance relative to following note:—“ Le métallificateur est congénéré des huiles, des graisses; c'est le même acidum puisque saturé de phlogistique et combiné avec moins d'eau; c'est le même acide qui est combiné avec les terres métalliques, qui forme les sels qu'on nomme chaux métalliques.”

\* The cuprum niccoli of the French. Niccolum Wallerii. This celebrated mineralogist says, “ Whence the mineral nickel acquired its name is uncertain. Nickel, perhaps, signifies the same thing as spurious or false.”

the phosphat of lime than is commonly found in the bones of quadrupeds, &c.

The different bones also of the same fish were various in this respect; and the bones about the head of the skate only differed from cartilage by containing a moderate proportion of phosphat of lime.

It is at present believed, that phosphat, with some sulphat of lime, constitutes the whole of the ossifying substance; and perhaps the formation of bone from cartilage depends only on the phosphat of lime; but whether this is the case or not, it is fit that I should notice a third substance, which constantly occurred in the course of my experiments.

When human bones or teeth, as well as those of quadrupeds and fish, whether recent or calcined, were exposed to the action of acids, an effervescence, although at times but feeble, was produced. This circumstance at first I did not particularly notice; but the following experiments excited my attention:

After the phosphat of lime had been precipitated from the solutions of various teeth and bones by pure ammonia, I observed that a second precipitate, much smaller in quantity, was obtained by the addition of carbonat of ammonia. This second precipitate dissolved in acids with much effervescence, during which carbonic acid was disengaged, and selenite was formed by adding sulphuric acid. Moreover the solution of this precipitate did not contain any phosphoric acid; nor did the liquor, from which the precipitate had been separated, afford any trace of it.

This precipitate was therefore carbonat of lime; but I still was not certain that it existed as such in the teeth and bones.

Although regular and comparative analyses of the bones of different animals have not hitherto been made, yet by the experiments of Messrs. Gahn, Scheele, Macquer, Foureroy, Berniard, and the Marquis de Bullion, it has been proved that phosphat of lime is the principal ossifying substance of bones in general, and that this is accompanied by a small proportion of saline substances, and by sulphat of lime.

I was therefore desirous to ascertain whether the carbonat of lime, which I had obtained by the above-mentioned experiments,

periments, had been produced from the sulphat of lime decomposed by the alkaline precipitant, or whether the greater part had not existed in the bones in the state of carbonat.

Each of the solutions in nitric acid afforded a precipitate with nitrat of barytes; but the quantity of sulphuric acid thus separated appeared by far too small to be capable of saturating the whole of the carbonat of lime obtained from an equal quantity of the solution. To prove, therefore, the presence of the carbonic acid, and the consequent formation of carbonat of lime, portions of the various teeth and bones were immersed at separate times in muriatic acid; and the gas produced was received in lime-water, by which it was speedily absorbed, and a proportionate quantity of carbonat of lime was obtained.

Although it appears that the principal effects during ossification are produced by the phosphat of lime, yet we here see that not only some sulphat, but also some carbonat of lime enters the composition of bones; and it is not a little curious to observe, that as the carbonat of lime exceeds in quantity the phosphat of lime in crustaceous marine animals and in the egg-shells of birds, so in bones it is *vice versa*. It is possible, when many accurate comparative analyses of bones have been made, that some may be found composed only of phosphat of lime; and that thus shells containing only carbonat of lime, and bones containing only phosphat of lime, will form the two extremities of the chain.

I shall now make a few remarks on the enamel of teeth.

When a tooth, coated with enamel, is immersed in diluted nitric or muriatic acid, a feeble effervescence takes place, and the enamel is completely dissolved; so also is the bony part; but the cartilage of that part is left, retaining the shape of the tooth. Or if a tooth, in which the enamel is intermixed with the bony substance, is plunged in the acid, the enamel and the bony part are dissolved in the same manner as before; that is to say, the enamel is completely taken up by the acid, while the tooth, like other bones, remains in a pulpy or cartilaginous state, having been deprived of the ossifying substance. Consequently, those parts which were seated or penetrated by lines of enamel are diminished in

proportion

proportion to the thickness of the enamel which has been thus dissolved; but little or no diminution is observed in the tooth\*.

Mr. Hunter has noticed this; and, speaking of enamel, says, "when soaked in a gentle acid, there appears no gristly or fleshy part with which the earthy part had been incorporated †."

Now when the difference, which has been lately stated between porcellaneous shell and mother-of-pearl, is considered, it is not possible to avoid the comparing of these to enamel and tooth.

When porcellaneous shell, whole or in powder, is exposed to the action of acids, it is completely dissolved without leaving any residuum.

Enamel is also completely dissolved in the like manner.

Porcellaneous shell and enamel when burned emit little or no smoke, nor scarcely any smell of burned horn or cartilage.

Their figure, after having been exposed to fire, is not materially changed, except by cracking in some parts; their external gloss partly remains, and their colour at most becomes gray, very different from what happens to mother-of-pearl or tooth. In their fracture they have a fibrous texture; and, in short, the only essential difference between them appears to be, that porcellaneous shell consists of carbonat of lime, and enamel of phosphat of lime, each being cemented by a small portion of gluten.

In like manner, if the effects produced by fire and acid menstrua, on shells composed of mother-of-pearl, and on the substance of teeth and bone, are compared, a great similarity will be found; for, when exposed to a red heat,

1st, They smoke much, and emit a smell of burned cartilage or horn.

2dly, They become of a dark gray, or black colour.

I have also observed, that when raspings of enamel are put into diluted nitric or muriatic acid, they are dissolved without any apparent reduction; but when raspings of tooth or bone are thus treated, portions of membrane or cartilage remain corresponding to the size of the raspings.

\* Natural History of the Human Teeth, p. 35.

3dly,

3dly, The animal coal thus formed is of different incineration.

4thly, They retain much of their original figure, but the membranaceous shells are subject to exfoliate\*.

5thly, These substances, (pearl, mother-of-pearl, tooth, and bone,) when immersed in certain acids, part with their hardening or ossifying substances, and then remain in the state of membrane or cartilage.

6thly, When previously burned, and afterwards dissolved in acids, a quantity of animal coal is separated, according to the proportion of the gelatinous, membranaceous, or cartilaginous substance, and according to the duration of the red heat.

And lastly, the acid solutions of these substances, by proper precipitants, afford carbonat of lime in the one case, and phosphat of lime principally in the other, in a proportion relative to the membrane or cartilage with which, or on which, the one or the other had been mixed or deposited.

As porcellaneous shell principally differs from mother-of-pearl only by a relative proportion between the carbonat of lime and the gluten, or membrane; in like manner the enamel appears only to be different from tooth or bone by being destitute of cartilage, and by being principally formed of phosphat of lime cemented by gluten,

The difference in the latter case seems to explain why the bones and teeth of animals fed on madder become red, when at the same time the like colour is not communicated to the enamel; for it appears probable that the cartilages, which form the original structure of the teeth and bones, become the channel by which the tingeing principle is communicated and diffused.

These comparative experiments prove that there is a great approximation in the nature of porcellaneous shell and the enamel of teeth, and also in that of mother-of-pearl and bone; and if a shell should be found composed of mother-of-pearl, coated by the porcellaneous substance, it will resemble a tooth coated by the enamel, with the difference of carbonat being substituted for phosphat of lime.

\* This is a natural consequence arising from their structure.

Some experiments on cartilaginous substances (which I intended to have inserted in this paper, but which I am prevented from doing, as they are not as yet sufficiently advanced) have in a great measure convinced me, that membranes and cartilages (whether destined to become bones by a natural process, as in young animals, or whether they become such by morbid ossification, as often happens in those which are aged) do not contain the ossifying substance, or phosphat of lime, as a constituent principle. I mean by this, that I believe the portion of phosphat of lime, found in cartilaginous and horny substances, to be simply mixed as an extraneous matter; and that, when it is absent, membrane, cartilage, and horn, are most perfect and complete.

The frequent presence of phosphat of lime in cartilaginous substances, is not a proof of its being one of their constituent principles, but only that it has become deposited and mixed with them in proportion to the tendency they may have to form modifications of bone, or according to their vicinity with such membranes or cartilages as are liable to such a change. If horns are examined, few, I believe, will be found to contain phosphat of lime in such a proportion as to be considered an essential ingredient. I would not be understood to speak here of such as stag or buck-horn, for that has every chemical character of bone, with some excess of cartilage; but I allude to those in which the substance of the horn is distinctly separate from the bone, and which, like a sheath, covers a bony protuberance which issues from the os frontis of certain animals\*.

Horns of this nature, such as those of the ox, the ram, and the chamois, also tortoise-shell, afford, after distillation and incineration, so very small a residuum, of which only a small part is phosphat of lime, that this latter can scarcely be regarded as a necessary ingredient.

By some experiments made on 500 grains of the horn of the ox, I obtained, after a long continued heat, only 1,50 grains of residuum; and of this less than half proved to be phosphat of lime.

\* Nature seems here to have made an analysis, or separation of horn from bone.

78 Grains of the horn of the chamois afforded only 0,50 of residuum; and 500 grains of tortoise-shell yielded not more than 0,25 of a grain, of which less than half was phosphat of lime.

Now, it must be evident that so very small a quantity cannot influence the nature of the substances which afforded it; and the same may be said of synovia, 480 grains of which did not yield more than one grain of phosphat of lime.

This substance is undoubtedly various in its proportions in all these and other animal substances, arising, probably, from the age and habit of the animal which has produced them; but I believe that I may at least venture to place some confidence in the foregoing experiments, as several others, made since the above was written, have tended to confirm them \*.

In the course of making the experiments which have been related, I examined the fossil bones of Gibraltar, as well as some glossopetræ, or shark's teeth. The latter afforded phosphat and carbonat of lime; but the carbonat of lime was visibly owing principally to the matter of the calcareous strata which had inclosed these teeth, and which had insinuated itself into these cavities, left by the decomposition of the original cartilaginous substance.

The bones of the Gibraltar rock also consist principally of lime, and the cavities have been partly filled by the carbonat of lime which cements them together.

Fossil bones resemble bones which by combustion have been deprived of their cartilaginous part; for they retain the figure of the original bone without being bone in reality, as

\* These experiments were repeated on bladders, which I chose in preference to any other membrane, as not being liable to ossification, and therefore likely to contain very little or no phosphat of lime. 250 grains of dry hog's bladder, after incineration, left a residuum, the weight of which did not exceed 1-50th of a grain. This was dissolved in diluted nitric acid; and upon adding pure ammonia, some faint traces of phosphat of lime were observed. Now, as 250 grains of bladder did not afford more than 1-50th of a grain of residuum, of which only a part consisted of phosphat of lime, there is much reason to regard this experiment as an additional proof that the phosphat of lime is not an essential ingredient of membrane.

one of the most essential parts has been taken away. Now such fossil or burned bones can no more be regarded as bone, than charcoal can be considered as the vegetable of which it retains the figure and fibrous structure.

Bones which keep their figure after combustion resemble charcoal made from vegetables replete with fibre; and cartilaginous bones which lose their shape by the same cause may be compared to succulent plants, which are reduced in bulk and shape in a similar manner.

From these last experiments I much question if bodies consisting of phosphat of lime, like bones, have concurred materially to form strata of limestone or chalk; for it appears to be improbable that phosphat is converted into carbonat of lime after these bodies have become extraneous fossils.

The destruction or decomposition of the cartilaginous parts of teeth and bones in a fossil state must have been the work of a very long period of time, unless accelerated by the action of some mineral principle; for, after having, in the usual manner, steeped in muriatic acid the os humeri of a man brought from Hythe in Kent, and said to have been taken from a Saxon tomb, I found the remaining cartilage nearly as complete as that of a recent bone. The difficult destructibility of substances of a somewhat similar nature appears also from the piercing implements formed of horn, which are not unfrequently found in excavations of high antiquity.

*XI. Description of an Air and a Water-Vault employed to equalize the discharge of Air into a Blast-Furnace. By Mr. DAVID MUSHET.*

**F**IG. 1. (Plate XI.) represents a vertical section of the elevation of an air-vault 60 feet long and 30 feet wide, consisting of four arches of regularly progressive sizes. This building is generally constructed under the bridgehouse, where the materials are daily collected for filling the furnace. AB, represents the acclivity to the furnace top. The space betwixt the arch-tops and the level of the floor is filled with materials as dense as can be procured. The walls of the under part

part are three feet thick, besides a lining of brick and plaster from 18 inches to two feet. Still further precautions are necessary, and alternate layers of pitch and stout paper are requisite to prevent the escape of the compressed air. C, a view of the arched funnel which conveys the air from the cylinder to the vault. Large iron pipes with a well fitted door are preferable, and less apt to emit air. D, an end view of the pipe by which the blast is carried to the furnace.

Fig. 2. is a horizontal section of Fig. 1. at the dotted line *ab*, representing the width of the cross arches, which are thrown in each partition to preserve an easy communication betwixt the vaults. D, is a section of the first range of pipes, meant to conduct the air to the furnace. In like manner pipes may be taken off from any part of the vault for the different purposes of blowing furnaces, fineries, hollow fires, &c.

Fig. 3. represents a vertical longitudinal section of what is generally called the water-vault. The walls of this building may be erected to the height of eight or nine feet, their thickness similar to those of the air-vault. A brick lining, and even puddling with clay betwixt it and the stone building, is necessary to prevent the water from oozing by the accumulated pressure. A, is an end view of the horizontal range of pipes which conveys the blast from the blowing cylinder to the inverted chest. BBB, the range which conducts the air to the interior of the inverted chest, and conveys it to the furnaces, proceeding along the extremities of the columns broken off at BB. C, an inverted chest made of wood, iron, or even of well-hewn flags set on end and tightly cemented, is 54 feet within in length, 18 feet wide, and 12 feet high. The dimensions, however, vary at different works. When the chest is made of wood or iron, it is generally bolted by means of a flange to the logs on which it is supported, lest the great pressure of air should overcome the gravitation of the chest, and displace it. DD, view of the centre log, and ends of the cross logs, on which the chest is laid. These should measure 18 inches in height, so as that the mouth of the chest may be that distance from the surface of the floor, and the water allowed to retreat from the interior of the chest with the least possible obstruction. EE, the out-

side walls of the building. FF, the brick-work, made perfectly water tight. The dotted line G, represents the surface of the water when at rest. Let the depth of the water, outside and inside of the chest, be estimated at four feet. When the engine is at work, should the pressure of the air have forced the water down to the dotted line H,  $3\frac{1}{2}$  feet distant from the line G, and only six inches from the mouth of the chest, it follows, that the water must have risen in the outer building, or chest,  $3\frac{1}{2}$  feet above G, and have its highest surface nearly at rest at I. In this case the strength of the blast is reckoned equal to seven feet of water, or nearly six inches of mercury. The space betwixt the chest and outside building is three feet. When the engine is at rest, and the water has assumed its level, the quantity of water within the chest should be equal to that without.

Fig. 4. is a ground plan of Fig. 3. The cross logs on which the cistern is supported are dotted within, but drawn full in the space betwixt the flange of the chest and outer building. The breadth of the flange-tops of the binding bolts, and thickness of the metal of the chest, are also drawn. The letters bear a reference to those in No. 3.

#### NEW PUBLICATIONS.

*The Chemical Pocket-Book, or Memoranda Chemica; arranged in a Compendium of Chemistry according to the latest Discoveries, &c. By JAMES PARKINSON. Symonds; Murray and Highley, &c. 230 Pages: 12mo. Price 5s.*

**O**N a plan of general arrangement, nearly similar to those of Fourcroy and Chaptal, Mr. Parkinson has brought together, in this little volume, almost all the *principles, facts, affirmations and theories* of modern chemistry. If we could be content with an assemblage of facts, not wrought into regular system, nor presented in continuous composition, few late chemical publications would deserve to be preferred to this one. In forming it, the compiler has laid under contribution

tribution every recent work from which any chemical gleanings could be gathered. His industry deserves praise, and his book cannot fail to be useful in no mean degree; though we fear that in a few cases he has admitted facts of uncertain authenticity, and theories not sufficiently supported.

*An Essay on the Theory and Practice of Bleaching, &c.* By WILLIAM HIGGINS, M. R. I. A. London: Vernor and Hood, 1799. 71 Pages: 8vo. Price 2s.

Science is truly beneficial only in its application to the uses of life. But for these uses, we should little value all the improvements of modern chemistry. There exists not, however, in any language, a treatise in which art and science are brought into alliance more happily than in that which is now before us. It was published at the request of the Right Hon. Mr. Foster and the Right Hon. Mr. Corry of the Irish House of Commons. It is intended for the perusal and instruction of actual bleachers. It explains the nature of flax, as being coloured by a resin that intimately pervades all its fibres. It explains in detail the practices of the old method of bleaching, which discharged the weaver's dressing by steeping in water; then, for a course of many weeks, applied alternate exposure to the open air, and steeping or boiling in alkaline lixivia, to bring all cloths of flax to perfect whiteness. It relates the manner of the applications of oxygenated muriatic acid in oxy-muriat of lime to abbreviate and perfect the bleaching process. It lastly proposes, as the cheapest and best of all modes of bleaching, the alternate use of steeps of oxy-muriat of lime, and steeps of sulphuret of lime, which in the course of ten days will bring green linen to a state of pure whiteness. We earnestly recommend this treatise to general attention.

*Transactions of the Royal Society of Edinburgh, Vol. V.  
Part I. for 1799.*

This Part contains the following papers:

I. Investigation of certain theorems relating to the figure of the earth. By Mr. Playfair.

II. Account of certain phenomena observed in the air-vault

vault of the furnaces of the Devon iron-works ; together with some practical remarks on the management of blast-furnaces. By Mr. Roebuck. (See the present number of the Philosophical Magazine, p. 324.)

III. Experiments on whinstone and lava. By Sir James Hall, Bart.

IV. A chemical analysis of three species of whinstone and two of lava. By Dr. Robert Kennedy.

V. A new method of resolving cubic equations. By James Ivory, Esq.

## INTELLIGENCE,

AND

## MISCELLANEOUS ARTICLES.

### LEARNED SOCIETIES.

#### ROYAL SOCIETY OF LONDON.

**S**INCE our last report, several interesting papers by Dr. Herschel, on the subject of his late discovery respecting heat and light, have been read. Doctor Herschel, pursuing his late discovery of what he calls the invisible heat-making rays of the sun, has investigated, and experimentally proved, that heat is occasioned by rays emanating from candent substances ; and that these rays have a power of heating bodies, and are subje&t to the laws of reflection and of refraction. The Doctor divides heat into six classes ; three of which are solar, and three terrestrial. On account of the similarity between the former and the latter, he reduces his subje&t to three general heads. He treats in his first division of the heat of the sun and of terrestrial flame ; in the second, of the heat of prismatic rays and of red-hot iron ; and in the third division, of the invisible heat-making rays of the sun, and of terrestrial invisible or dark heat in general.

Papers on the following subjects have also been read :

An account of an earthquake felt in the vale of Conway, between Conway and Llanrwst, on the 12th of March last.  
By J. Lloyd, Esq.

Experiments on platina. By Wm. Bingley, Esq. assay-master of the Mint.

A postscript by Mr. Howard to his paper on fulminating oxyd of mercury, containing an account of some experiments made with it at Woolwich; from which it appears, that 1 oz. burst a shell which would have required 7 oz. of gunpowder; and that half the charge of oxyd usually employed of gunpowder would burst any piece of ordnance. A remarkable property of this preparation is, that when fired with gunpowder the latter does not deflagrate.

A paper, by S. Schroeter, on the planet Mercury. From his observations it appears, that its mountains bear the same proportion to its diameter as those of Venus and the Moon do to theirs, and that the highest mountains are in its southern hemisphere; also, that its rotation on its axis is performed in seventy-four hours.

#### PHILOMATIC SOCIETY OF PARIS.

C. Jurine read lately a memoir on the *monoculus castor*. Under this name the author includes the *monoculi* of which Muller very improperly formed three species, *viz.* the *cyclops*, *cæruleus*, *rubens*, and *lacinulatus*. The *cæruleus* is nothing else, indeed, than an old female of the *rubens*; and the character of the *lacinulatus* consists merely in foreign appendages, or a kind of infusion animals which often adhere to this *monoculus*. C. Jurine having successively reduced several of these insects to a state of asphyxy by means of a few drops of spirits thrown into the water which contained them, and having revived them by adding new pure water, observed, that it is not the heart but the intestinal canal which retains longest its irritability, and resumes it the soonest. The female carries her eggs not in two clusters, like the greater part of the other cyclops, but in a large bag, which has a little resemblance to the tail of the beaver. It is from this circumstance that the author gives to the above species the name

name of *castor*. The right antenna of the male has a hinge by means of which he lays hold of the threads that terminate the tail of the female to force her to copulate. When the two sexes copulate, they are in an opposite direction.

C. Cuvier read a note on the fossil tapirs of France. The author announced, that there are dug up in France the bones of two kinds of tapirs; one of the size of the common tapir, which is no longer found alive in America, and the other of a size equal to that of the hippopotamus, and of which living individuals no where exist. Both these kinds, like the common tapir, have teeth (grinders) the summit of which is marked with two or three transversal eminences or ridges that become blunted with age. Among the animals known at present, there is none but the *lamantin* which participates in this character with the tapir. The want of incisive and canine teeth, however, and the form of the jaw-bones of the lamantin, by no means permit them to be confounded with those of the tapir. The author has seen two considerable portions of the lower jaw of the former, or small species, in the cabinet of C. Drée. They were found on the last declivities of the Black Mountain, near the village of Issel, in the department of Herault, in a bed of coarse gravel. They have no sensible difference from the analogous parts of the common tapir. In regard to the large species, the author knows of four specimens: 1. An extreme grinder found in a ravine near Vienne, in Dauphiny, and described and illustrated by a figure in the *Journal de Physique* for February 1773: 2. A considerable portion of a grinder found by C. Gilet-Laumont at Saint-Lary, in Comminge: 3. The germ of a grinder without roots, preserved in the National Museum of Natural History: and 4. The two halves of a lower jaw, containing each five grinders, but broken at both ends, and consequently without the incisores or canine teeth, and without any determinate form. It may be easily seen that four of these grinders have transversal eminences, as those of the tapir; and that the one before is alone flat at the top, and without any protuberance. It is probable that the animal was not full grown, since it wanted the extreme grinder with three protuberances, and that the one next to it had not been used. From the size of these teeth

teeth it evidently appears, that the animal to which they belonged must in bulk have been equal at least to the hippopotamus, or perhaps to the elephant. It is not known where these two portions of the jaw were found; they are in part incrusted with sand.

C. Lasteyrie, who is now travelling through the north of Europe, has addressed a letter to the Society on the introduction of the fine-woollen breed of sheep into the cold countries. Near Leyden and Haarlem, in Holland, he observed that the climate, though damp, does not prevent the breed of the Spanish sheep from thriving. He saw the fourth generation of these animals, bred in the country, which had as fine wool as the Spanish sheep, though both the soil and the climate were in appearance very unfavourable to the constitution of these animals. In another letter he says he found the same success in Denmark and Sweden, and even in the most northern parts of these two countries, where that breed have existed for many years. He mentions in particular, that the Danish government, two years ago, sent for three hundred Spanish sheep, only one of which has died in the course of that time notwithstanding the severe cold of the last winter.

In the annual sitting on the 10th of January C. Sylvester made a report of the labours of the Society during the year. At the same time

C. Lacroix read the eulogy of Borda, and C. Coquebert that of Bloch.

#### BRITISH MINERALOGICAL SOCIETY.

This Society has just circulated the following notice of its proceedings :

" It is now some months since public notice was given of the institution of the British Mineralogical Society; one of the principal objects of which is, the gratuitous analysis of such of our native minerals as may be sent to the Society by mine-owners, or other persons who are interested in the inquiry. The Society's first meetings were necessarily much occupied in establishing arrangements for the most effectual attainment of its own designs and those of its correspondents. Both these objects have, we trust, been satisfactorily provided

for; and the number of specimens sent to the Society for analysis, evince at the same time the utility of the scheme and the public confidence.

" The Society consists of a competent number of members in the habitual practice of chemical operations, each of whom undertakes an analysis in rotation, (assisted, in cases of peculiar intricacy, by a select committee,) the result of which, after general approbation, is transmitted by the secretary to the person who sent the specimen. Since, however, several of our correspondents, from inadvertence, have not complied with the conditions mentioned in the circular letter of the Society, we here repeat them, with the addition of some others, and beg to have it understood that no analysis will be undertaken where these are not complied with :

" 1. The whole of each specimen must be at least four pounds weight, and in as few pieces as possible. The person who sends the specimens, if more than one, should break a small piece from each, taking care to reserve and mark them with the same numbers as those that he sends to the Society; because, in the analysis returned to him, the different specimens will be distinguished by their numbers : the safest way of marking each will be to write the number on a slip of paper, and fix it on the specimen with gum-water. Every piece must be wrapped in paper, and packed in a box with saw-dust, addressed (carriage paid) to Mr. W. H. Pepys, Poultry, London.

" 2. A paper must accompany the specimens, stating their provincial names ; the name of the parish and county where they are found ; the depth of the mine or quarry where they are procured ; the general extent and bearing of the vein or stratum towards the points of the compass ; and the method of procuring them, whether by blasting or by the pick-axe, &c.

" 3. The Society also requests, that the metallic ores which may be sent them for analysis may be accompanied with specimens of the gangue or matrix in which they are found, and of the superincumbent strata, with their respective depths and provincial appellations, according to the following form \* :

\* The blanks, and parts printed in *Italics*, to be occupied by their proper description.

" Specimen No. 1, called by the miners [steel-grained potter's lead ore] found at [ ] mine, in the parish of [ ] county of [ ]; [40] fathoms below the surface, in a [regular vein from 2 to 24 inches across] lying [N. W. and S. E.] rising to the [N. W.], procured by [blasting]. The ore found mixed with [black-jack specimen No. 2, and spar No. 3,] in a [slate-rock]. Depth of strata cut through in sinking the mine, [soil 1 foot; gravel 5 feet, No. 4; rock 30 fathoms, Nos. 5 and 6; shale 2 fathoms, No. 7; slate-rock 7 fathoms, No. 8.]

" The Members of the British Mineralogical Society have in view, besides the above, another object of perhaps still greater general importance. In common with all other inquirers into this most interesting department of natural history, they have regretted the formidable obstacles to collecting accurate information in the mining districts, originating from the vague and peculiar terms in use among the miners, and from the different ideas annexed to the same terms in different parts of the country. They feel the impossibility of introducing a scientific nomenclature into the mines and collieries, and in consequence have arranged correspondences in various parts for the purpose of collecting materials towards a general explanatory dictionary of all the mining terms made use of in the British islands. The success of this plan, it is obvious, depends essentially on the public concurrence; its advantage cannot be called in question, and therefore the Society requests with confidence the assistance of those gentlemen who, from their local situation, or other circumstances, are able to further its execution, and are willing that the whole science of mineralogy should be cleared from that confusion and mystery in which it has been enveloped. Besides lists and explanations of technical terms, the Society wishes to be furnished with specimens of such minerals as have received any names in the mines and collieries: without the possession of specimens it will be impossible to identify the substances so as to assign them their proper scientific appellations; and these being deposited in the cabinet of the Society, will form a constant record and authority, to which the most liberal access will at all times be allowed.

"The consciousness of contributing in their sphere to the public good, and to the improvement of a favourite branch of natural science, is the sole remuneration which the Members of the Society look forward to; and they will esteem the time and expense employed in the analysis of minerals amply repaid, if those whom they have thus served will exert their personal activity and influence among their workmen, in furthering the execution of the above design, by the communication of illustrative specimens and explanatory lists of technical terms.

"It is the intention of the Society to associate as corresponding Members a select number of such persons, competently skilled in mineralogy, as may be zealous to assist its views; and that proprietors of mines, who have it much in their power to furnish such facts and specimens as are of principal importance to the Society, shall be considered as eligible to the class of corresponding Members; all of whom, though they are to be subject to no pecuniary contribution, shall be allowed free access to the meetings and to the cabinet."

#### GALVANISM.

Mr. Carlisle has lately made some interesting experiments which prove the identity of the electric and galvanic fluid. A number of plates of silver (say, 40 or 50 crowns or half-crowns) piled alternately with plates of zinc, with pieces of wetted pasteboard between each to complete the galvanic chain, will not only give an electric shock to the person who touches the top and bottom of the series, but continue to give an uninterrupted stream of the electric fluid, which being passed through water, decomposes it completely. If gold, silver, or platina wire be employed to carry the electric matter into and from the water, both oxygen and hydrogen are liberated; but if oxydable metals are employed, hydrogen only.

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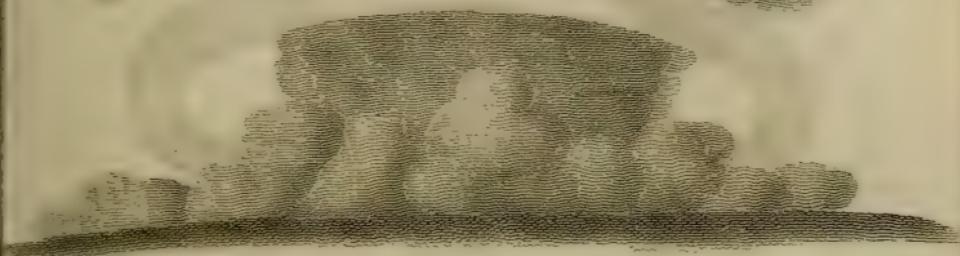
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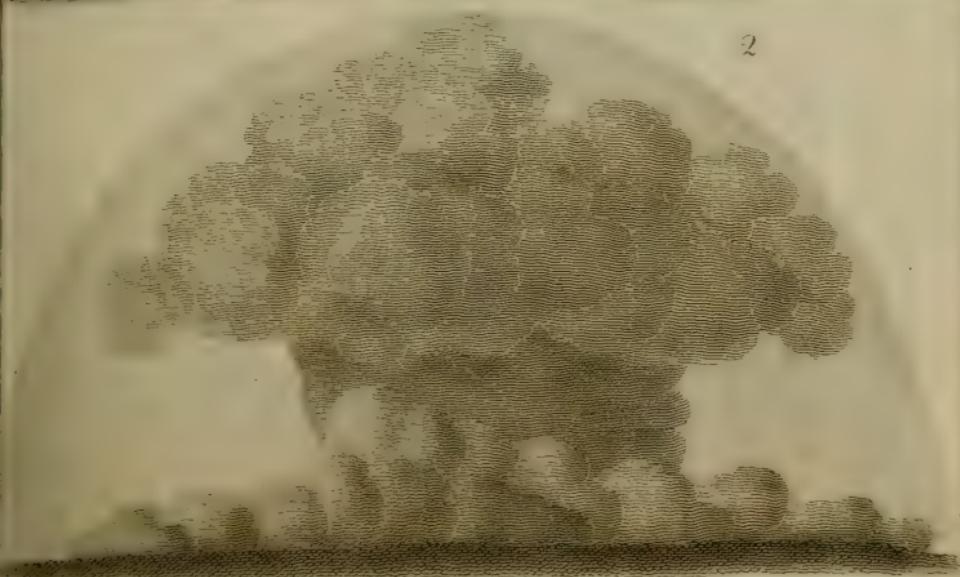


END OF THE SIXTH VOLUME.

*Fig. 1*



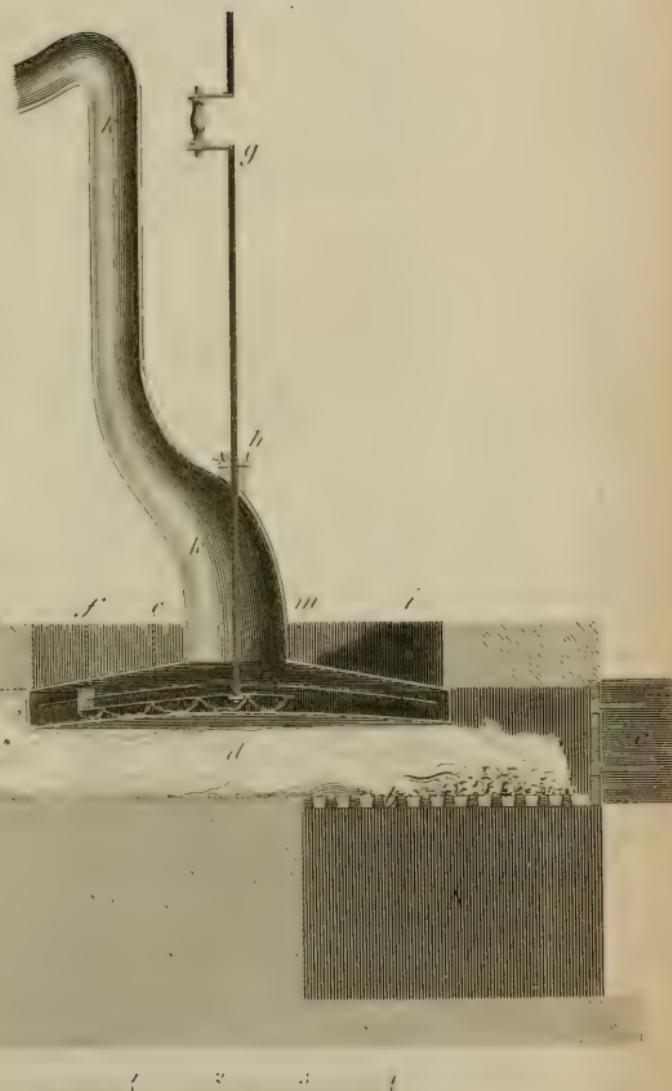
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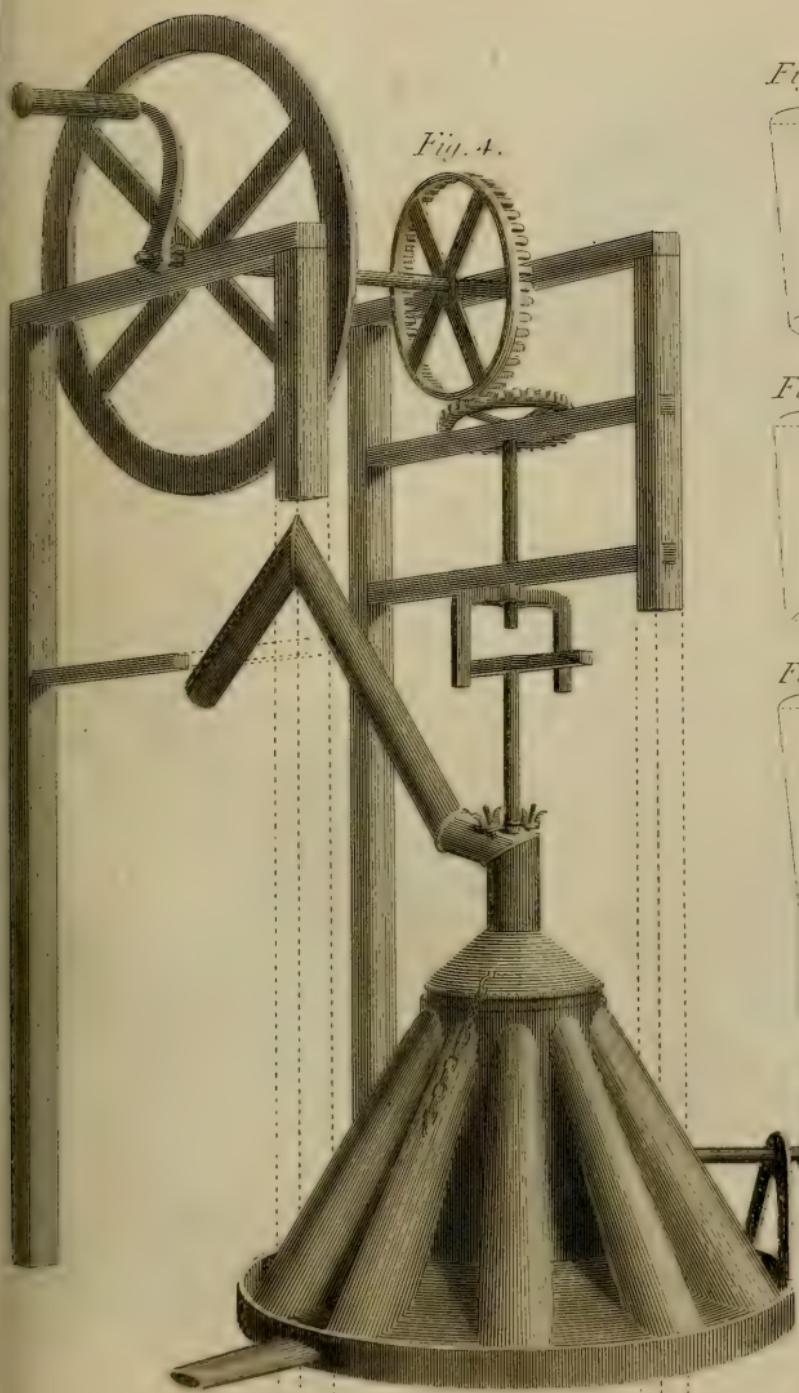










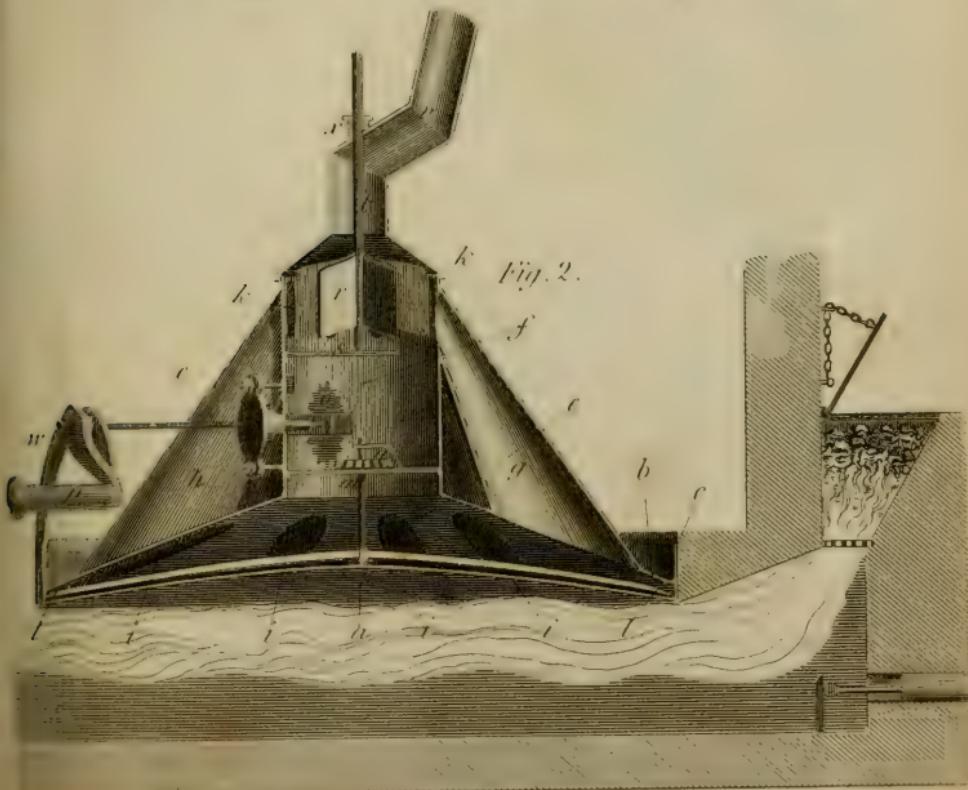
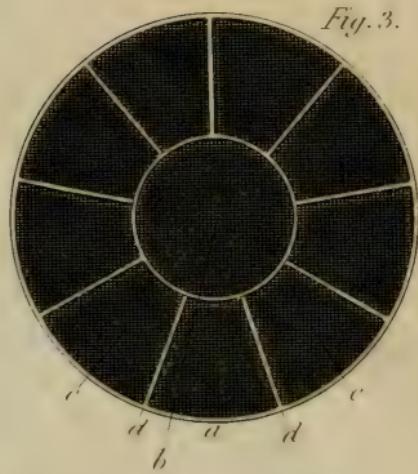
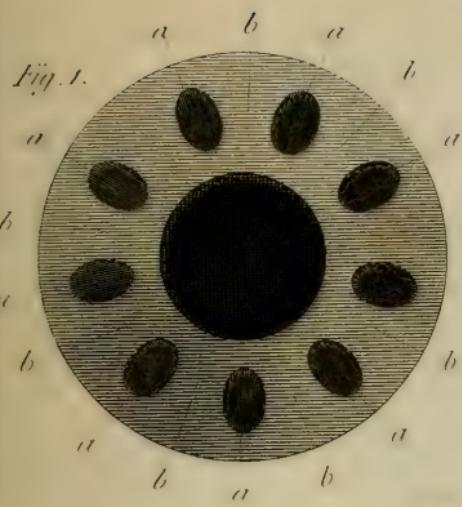


*Fig. 1.*

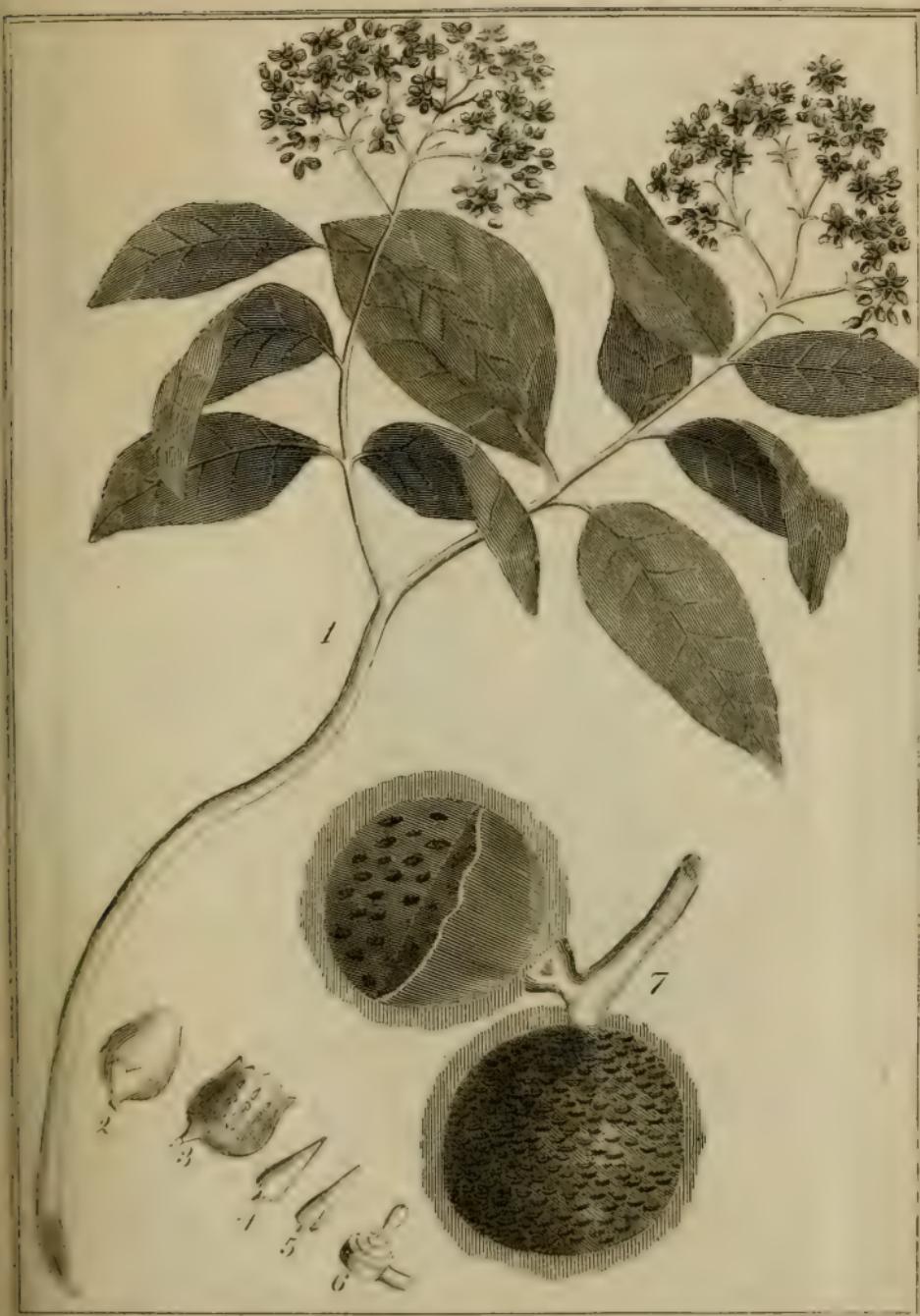
*Fig. 2.*

*Fig. 3.*



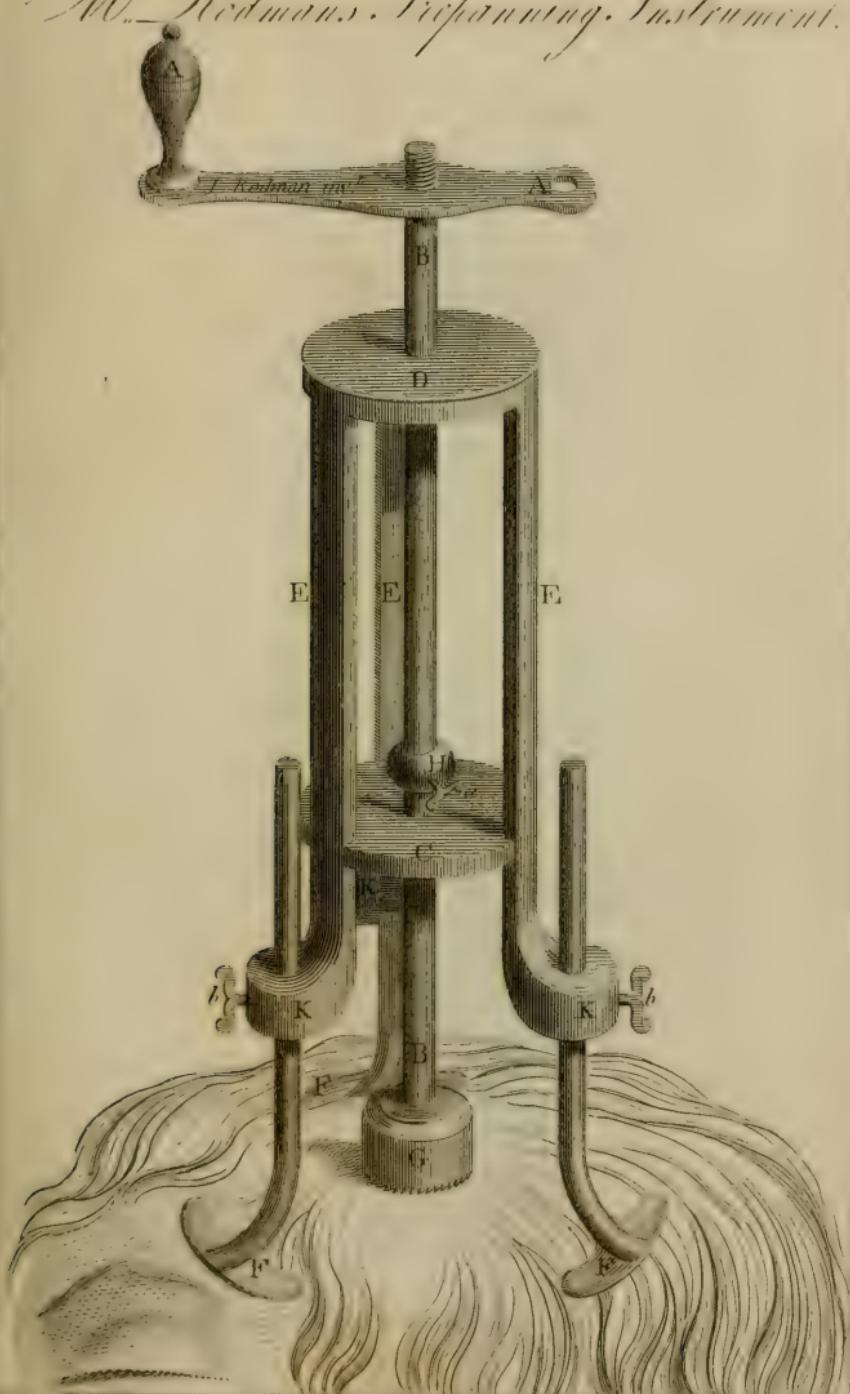




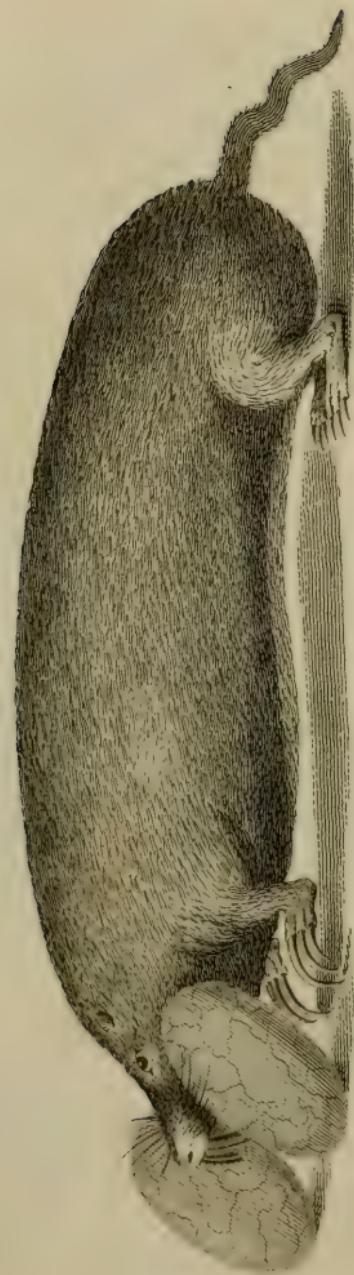




( ) Mr Redman's Tropanning Instrument. ( )



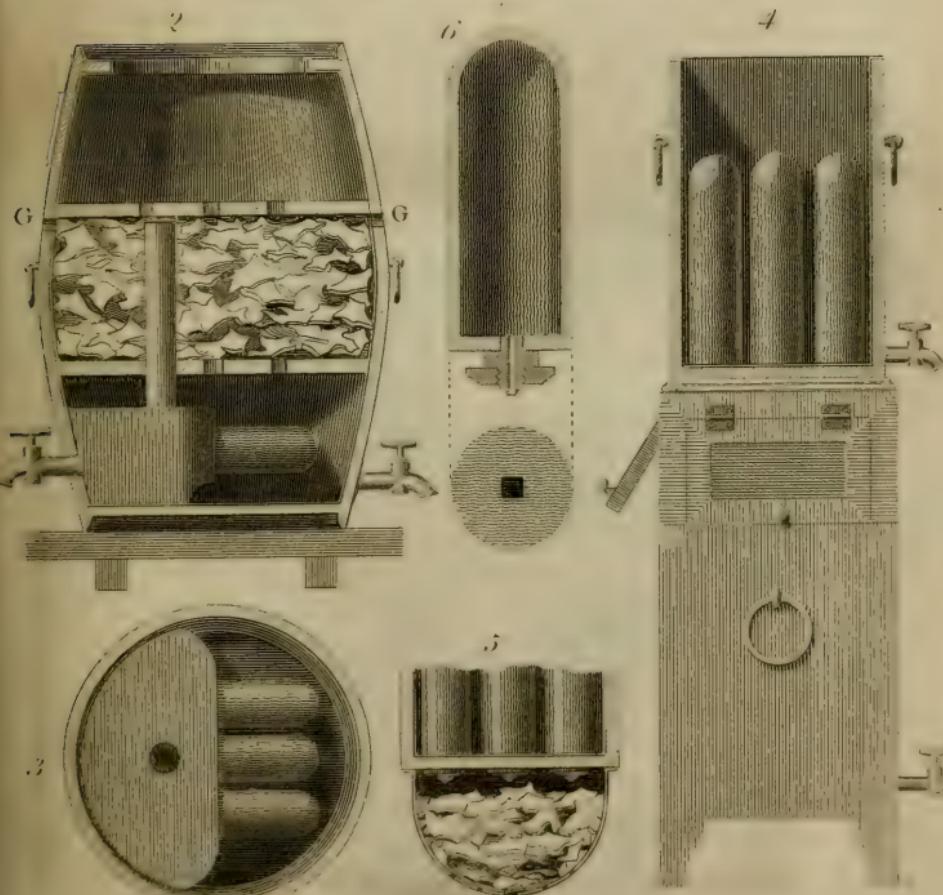
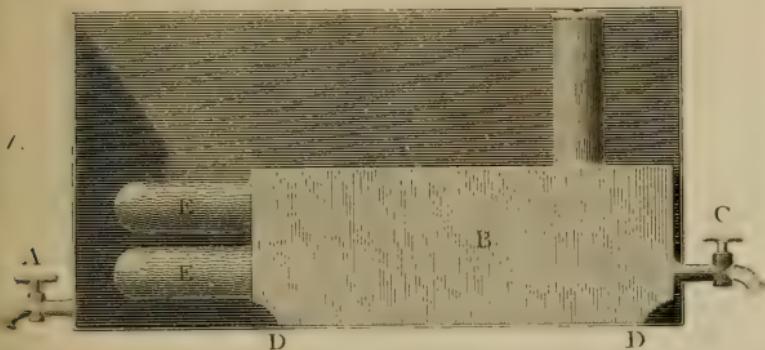




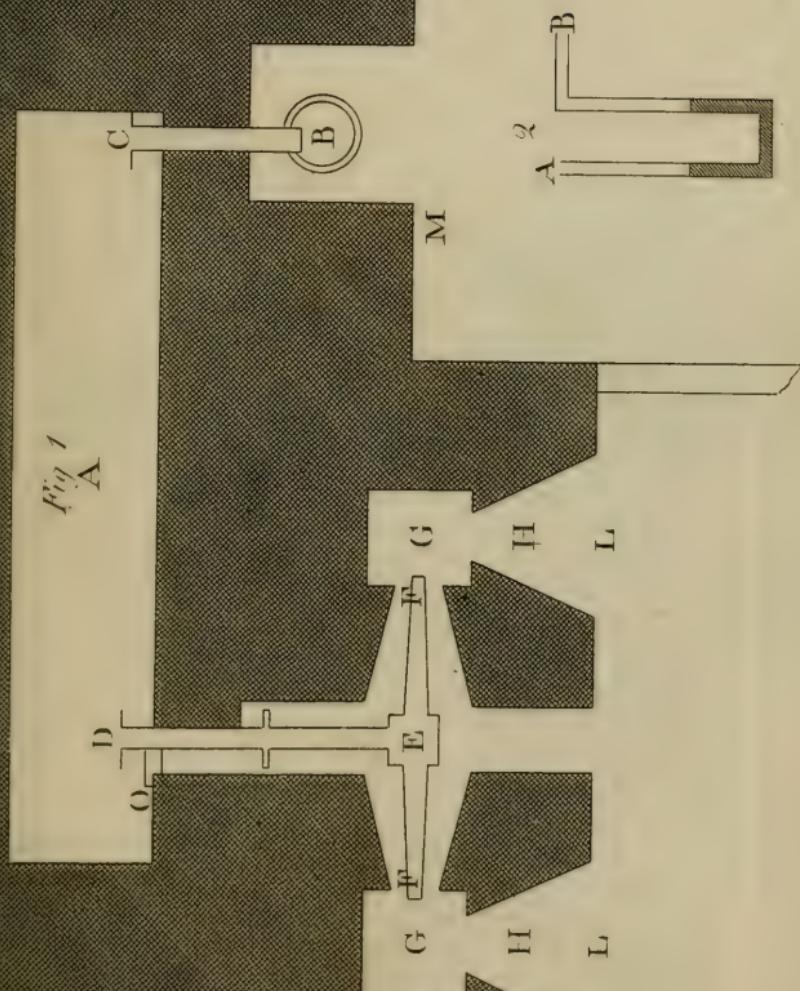


Cultivator improved. Apparatus.

Fig. 1.

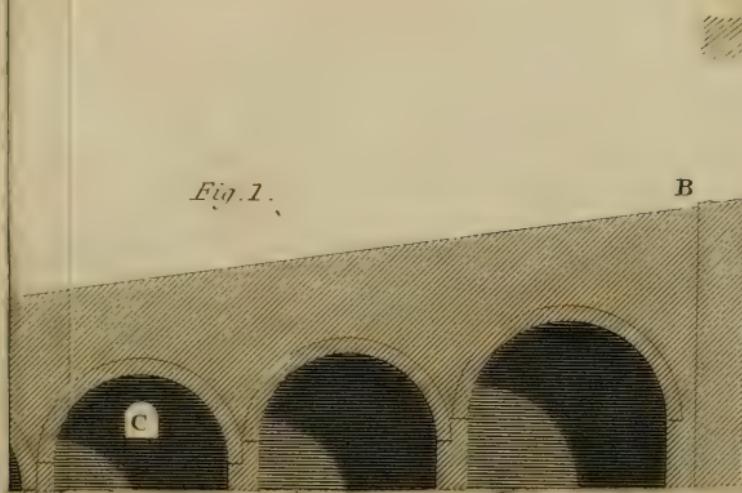






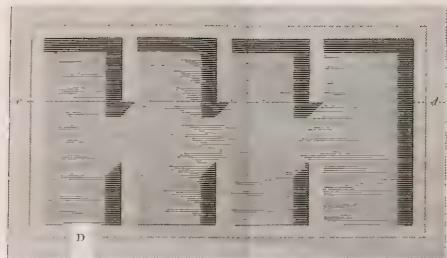


*Fig. 1. A section of the Wall.*

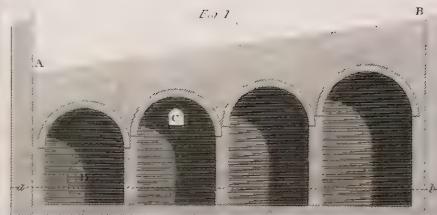


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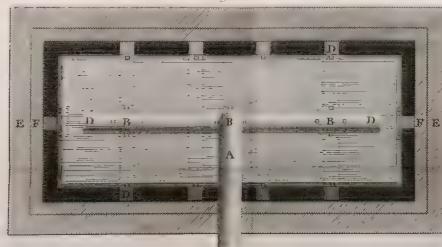
*Fig. 3*



*Fig. 4*



*Fig. 5*



*Fig. 6*

